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STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
GEORGE D. NORDENHOLT, Director

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY State Mineralogist

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MINES AND GEOLOGY

QUARTERLY CHAPTER
OF
STATE MINERALOGIST'S REPORT XXXII

STATE DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO
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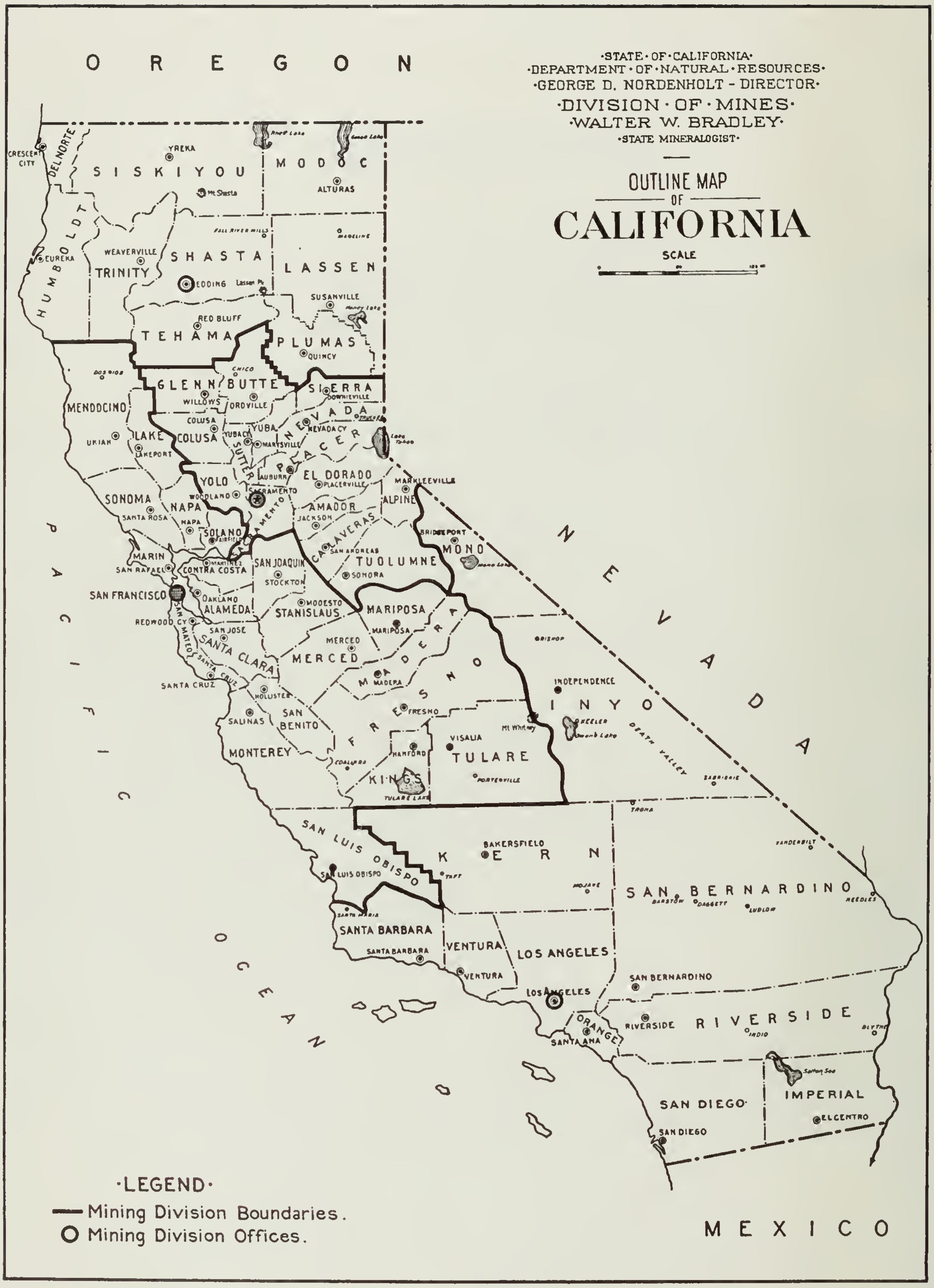

·STATE·OF·CALIFORNIA·
·DEPARTMENT·OF·NATURAL·RESOURCES·
·GEORGE D. NORDENHOLT - DIRECTOR·
·DIVISION·OF·MINES·
·WALTER W. BRADLEY·
·STATE MINERALOGIST·

OUTLINE MAP OF CALIFORNIA

SCALE
OREGON
NEVADA
MEXICO
PACIFIC OCEAN
DEL NORTE
CRESCENT CITY
SISKIYOU
YREKA
Mt. Shasta
MODOC
ALTURAS
HUMBOLDT
EUREKA
TRINITY
WEAVERVILLE
SHASTA
REDDING
Lassen Pk.
LASSEN
SUSANVILLE
TEHAMA
RED BLUFF
PLUMAS
QUINCY
GLENN
WILLOWS
BUTTE
CHICO
OROVILLE
SIERRA
DOWNIEVILLE
MENDOCINO
UKIAH
LAKE
LAKEPORT
COLUSA
YUBA
MARYSVILLE
SUTTER
YUBA CITY
NEVADA
NEVADA CY.
TRUCKEE
Lake Tahoe
PLACER
AUBURN
YOLO
WOODLAND
SACRAMENTO
EL DORADO
PLACERVILLE
ALPINE
MARKLEEVILLE
SONOMA
SANTA ROSA
NAPA
SOLANO
FAIRFIELD
AMADOR
JACKSON
CALAVERAS
SAN ANDREAS
MONO
BRIDGEPORT
Mono Lake
MARIN
SAN RAFAEL
CONTRA COSTA
MARTINEZ
SAN JOAQUIN
STOCKTON
TUOLUMNE
SONORA
SAN FRANCISCO
OAKLAND
ALAMEDA
STANISLAUS
MODESTO
MARIPOSA
REDWOOD CY.
SAN MATEO
SAN JOSE
SANTA CLARA
MERCED
MADERA
BISHOP
INDEPENDENCE
INYO
SANTA CRUZ
HOLLISTER
SAN BENITO
SALINAS
FRESNO
Mt. Whitney
KEELER
Owens Lake
DEATH VALLEY
MONTEREY
COALINGA
HANFORD
KINGS
Tulare Lake
VISALIA
TULARE
PORTERVILLE
SKIDOO
TRONA
SAN LUIS OBISPO
KERN
BAKERSFIELD
TAFT
MOJAVE
VANDERBILT
SAN BERNARDINO
BARSTOW
DAGGETT
LUDLOW
NEEDLES
SANTA MARIA
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
ORANGE
SANTA ANA
RIVERSIDE
INDIO
BLYTHE
Salton Sea
SAN DIEGO
IMPERIAL
EL CENTRO
·LEGEND·
Mining Division Boundaries.
Mining Division Offices.

PREFACE

The Division of Mines (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

As a progressive step in advancing the interests of the mineral industry, and as permitting earlier distribution to the public, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923. Owing to a lack of funds for printing this was changed to a quarterly publication, beginning in September, 1923. For the same reason, beginning with the January, 1924, issue, it became necessary to charge a subscription price. This covers approximately the cost of printing.

Pages are numbered, consecutively throughout the year and an index to the complete report is included annually in the closing number.

Beginning with the 1930 issues, the activities and progress of the Geological Branch are recorded also in these quarterly chapters. The important part that geology plays in the economic development of our mineral resources is further recognized in the change of title from *Mining in California* to CALIFORNIA JOURNAL OF MINES AND GEOLOGY, beginning with the January, 1933, chapter.

While current activities of all descriptions are covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters are subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

Types of Reports

In general the reports presented in these chapters are grouped into three classes:

1. Mines and mineral resources of a given county (describing kind, character, distribution and extent of development).

2. Specific economic and industrial mineral products (listing and describing the resources over the entire state of a given mineral substance, e.g. feldspar).

3. Geological reports on specific areas (recording results and conclusions, with maps, derived from field studies; and tied in with economic possibilities, and developments).

REPORTS OF DISTRICT MINING ENGINEERS

In 1919–1920 the Mining Bureau was organized into four main geographic divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work, including lower traveling-expense bills for the Bureau's engineers. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions and the location of the branch offices are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each district, prepared by the District Engineer, will continue to appear under the proper field division heading.

REDDING FIELD DISTRICT

CHAS. VOLNEY AVERILL, Mining Engineer

There is no report from the Redding Field District. Mr. Chas. V. Averill, District Mining Engineer, is engaged on investigations for a new report upon the mines and mineral resources of Plumas, Lassen and Modoc counties.

SACRAMENTO FIELD DISTRICT

C. A. LOGAN, Mining Engineer

GOLD MINES OF PLACER COUNTY

Foreword.

Placer County, taking its name from the Spanish meaning a place where gold is obtained by washing, had no history before the discovery of Woods Dry Diggings (on Auburn Ravine at the lower end of old Auburn), May 16, 1848. The name has proven a peculiarly appropriate one, for the variety, extent and richness of the gold placer mines found within its borders have been remarkable. Particularly notable were the deposits in the present American River and the great series of buried river channels of the Forest Hill Divide, Dutch Flat, Gold Run and the Iowa Hill district. For a region that has produced so much placer gold, the quartz mines found so far have not been extensively worked. The other mineral resources include the clay beds near Lincoln, which support the largest pottery in the state; granite quarries, now mostly idle but once employed several hundred men at Penryn and Rocklin; copper, chromite, iron ore (this county having once supported the only blast furnaces utilizing California ores); limestone, and many of less importance.

The present article is confined to gold mines and mining, there having been little change in the status of deposits of other minerals, which are described in the 23d Report of the State Mineralogist (1927).

Topography, Rainfall.

Placer County extends from the eastern side of Sacramento Valley to the Nevada state line, including a large part of Lake Tahoe, and the Sierra Nevada extend along the eastern boundary so that a great variety of scenery and climate can be found in a few hours' driving. The amounts and character of precipitation are equally varied, ranging from a mean annual fall of about 22 inches at Rocklin (elevation 249 ft.) and 33¾ inches at Auburn (elevation 1360 ft.) with no snow worth mentioning, to 65 inches at Blue Canyon (elevation 4695 ft.) where snowfall is heavy. Deciduous fruit-raising is the principal industry of the western section, as far up the Sierran foothills as Auburn. Mining and summer grazing of cattle and sheep are carried on in the mountains and at present both quartz and placer mining are active in such districts as Penryn, Lincoln and Ophir as well, where it is no uncommon sight to see gold being produced from beneath fruit orchards or on other farming land. Water for generating electric power and for irrigation and mining is stored in the high mountains and is generally available. The main line of the Central Pacific Railway to Ogden crosses the entire county, passing over the Sierra Nevada at an elevation of 7017 ft. and a fine state highway follows nearly the same course, with good roads reaching all parts of the county. Good pine timber is abundant in the mountains above 3000 ft.

GOLD QUARTZ MINES

GEOLOGY

The quartz mining districts of this county are scattered and contain examples of many different types.

Mines of the Western Granite Batholith Region.

On the western side of the county bordering the Sacramento Valley, granitic rocks (principally granodiorite, but showing variations ranging from a true granite at Rocklin to gabbro and gabbrodiorite a few miles farther east) extend for 18 miles north and south and 9 miles east and west. The numerous small mines of the Ophir district, and those now being operated near Penryn, are along the eastern border of this batholith, most of them being not far from the contact with amphibolite schist, and many outcropping in the schist. The Ophir mines have produced several million dollars, but at present only small-scale work is going on there. The developments have reached 1200 ft. in depth at only one mine. Oro Fina Mine, last worked in 1922, has been the largest producer with a gross output of over one-half million dollars to an inclined depth of 700 ft., in the schist. However, the Zantgraf Mine, in the amphibolite schist at the border of this same batholith, and

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MINERAL PRODUCTION OF PLACER COUNTY, 1880-1934.

Year	Gold, value	Silver, value	Copper		Brick		Pottery clay*		Lime and limestone		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
			Pounds	Value	M.	Value	Tons	Value		Amount		Amount	Value	Substance
1880	$838,133	$640												
1881	850,000	6,500												
1882	800,000													
1883	810,000													
1884	887,320	5												
1885	906,301													
1886	1,071,663	1,397												
1887	855,510	556												
1888	850,000	1,000												
1889	1,245,491	1,975												
1890	1,003,602	1,045												
1891	998,495	5,921												
1892	1,159,080	2,120												
1893	1,351,250	616												
1894	1,851,215	664					22,000	$27,500			$67,200			
1895	1,599,635	5,273					15,000	15,000			56,620	25 tons	$1,000	Asbestos.
1896	1,674,844	6,690					10,000	10,000			44,216			
1897	1,524,941	6,784					7,500	7,500			39,412			
1898	1,488,022	5,670					12,000	12,000			29,833			
1899	1,100,081	1,206					15,000	15,000			61,525			
1900	986,155	12,058					15,000	15,000			115,669			
1901	900,745	4,828	11,200	$1,764			15,000	15,000			102,847			
1902	843,366	3,341	3,200	368			15,000	15,000			156,402			
1903	570,571	1,116	4,000	520			15,000	15,000	[2]1,500 [3]4,000	$9,000 4,000	198,530		280 1,968	Platinum. Quartz.
1904	778,355	9,320	600,000	76,500			16,100	16,100			123,448		375	Platinum.
1905	597,793	8,041	367,250	57,291			20,000	10,000	[3]15,533	8,737	116,746	2 ozs.	36	Platinum.
1906	572,906	13,234	200,000	38,600			20,000	15,000	[3]11,699	11,950	71,130	0.66 ozs. 50 tons	12 2,500	Platinum. Asbestos.
1907	482,772	3,338					20,000	20,000	[2]11,430 [3]38,869	11,430 79,768	118,722	70 tons	3,500	Asbestos.
1908	358,096	2,194			13,000	$46,300	13,000	11,500	[2]1,727	1,710	178,460	50 tons	5,000	Asbestos.
1909	281,372	1,492			2,083	52,300	45,300	35,250	[2]24,322	25,864	203,783	 60 tons	276,222 6,000	Unapportioned, 1901-1909. Asbestos.
1910	257,191	1,157			600	23,438	44,000	27,000	[2]10,000	12,100	242,773	200 tons	20,000	Asbestos.
1911	251,298	2,585	118,624	14,828	700	18,000	43,120	29,200			218,951	125 tons 300 tons 90 tons	500 3,300 584	Asbestos. Magnesite. Mineral paint.
1912	367,383	4,791	78,170	12,898	900	21,250	56,000	41,300	[3]222,595	200,000	231,415	50 tons 1,000 tons	500 2,000	Magnesite. Glass sand.
1913	220,785	2,972	429	67	1,900	40,000	63,600	47,200			205,749	805 lbs. 2,000 tons	35 4,000	Lead. Quartz.
1914	600,000	4,500	453	60	2,000	40,000	63,700	49,000	[3]202,575	202,575	203,593	385 lbs.	15	Lead.
1915	414,319	24,543	[4]		2,000	40,000	49,126	37,536	[3]1,236	2,432	98,187	711 lbs. 	33 346,810	Lead. Asbestos and copper.
1916	428,400	24,928	1,437,441	353,610	2,540	79,000	29,018	36,230			17,026	744 tons 	11,956 80,931 10.548	Chromite. Granite. Lead. limestone, magnesite.
1917	538,686	13,885	710,601	193,994	[4]		44,097	44,097			10,727	4,287 tons 	105,384 30,392 92,624	Chromite. Granite. Asbestos, brick, platinum, tile, gems, magnesite.
1918	230,190	22,432	837,527	206,869	and tile	81,408	29,348	29,348			4,266	4,963 tons 	276,765 30,882 21,360	Chromite. Granite. Manganese and silica.
1919	170,609	3,141			[4]		[4]				4,330	1,018 tons 	24,000 98,513 36,233 1,055	Chromite. Clay and clay products. Granite. Other minerals.
1920	151,088	2,178			and tile	149,924	65,560	76,500			6,688	300 tons 	7,985 212,625 5,825	Chromite. Granite. Other minerals.
1921	132,468	1,068			and tile	144,508	76,665	95,930			21,490	 	48,328 5,278	Granite. Chromite, mineral paint, silica.
1922	119,673	952			and tile	118,707	79,531	111,166			24,430	 2,000 tons 	12,980 5,500 12,477	Granite. Silica. Other minerals.[5]
1923	75,732	297					82,919	143,097			139,829	 3,656 tons 	5,146 10,040 120,372	Granite. Silica (quartz). Other minerals.[6]
1924	108,757	534			and tile	186,053	97,670	146,508			15,573	 	19,155 15,600	Granite. Other minerals.[7]
1925	121,785	620			and tile	147,981	102,598	138,813			117,990	 	14,929 8,295	Granite. Other minerals.[8]
1926	82,921	346			and tile	150,591	104,250	147,241			81,814	6,092 cu.ft. 	11,969 6,000	Granite. Other minerals.
1927	97,494	440					61,388	106,710			40,357	8,590 cu.ft. 	18,109 8,100 89,104	Granite. Silica. Other minerals.
1928	71,959	338					110,353	163,644			23,096	 	19,655 54,443	Granite. Other minerals.[9]
1929	34,691	133					118,704	158,531			9,469	 	20,385 43,136	Granite. Other minerals.[10]
1930	29,338	73					85,377	116,642			133,339	 	15,841 28,484	Granite. Other minerals.[11]
1931	72,409	271					78,501	122,515			55,666	 	6,300 28,687	Granite. Other minerals.[12]
1932	104,089	284					35,825	49,037			40,405	 	22,625 23,808	Granite. Other minerals.[13]
1933	167,774	475					40,658	59,261			41,761		24,595	Other minerals.[14]
1934	547,892	6,987	1,953	156			38,975	60,555			33,413		29,229	Other minerals.[15]
Totals	$34,634,645	$226,924	4,370,848	$957,525		$1,339,550	1,876,883	$2,291,911		$569,566	$3,706,889		$2,450,318	

---

[1] Includes granite (prior to 1916), crushed rock, rubble, rip-rap, paving blocks, sand, gravel.
[2] Barrels of lime.
[3] Tons of limestone.
[4] See under 'Unapportioned.'
[5] Includes chromite, mineral paint, mineral water.
[6] Includes brick, building tile, chromite.
[7] Includes mineral paint, mineral water, silica (quartz).
[8] Includes chromite, copper, silica (quartz).
[9] Includes brick and hollow building tile, copper, mineral paint, mineral water.
[10] Includes brick, hollow building tile, mineral paint, silica.
[11] Includes brick and hollow building tile, copper, mineral paint, silica (quartz), chromite.
[12] Includes brick and hollow building tile, chromite, copper, mineral paint, mineral water, silica (quartz).
[13] Includes brick and hollow building tile, copper, mineral water.
[14] Includes brick, chromite, copper, granite, lead, mineral water.
[15] Includes brick, granite, lead, mineral water, chromite.
* Figures for value of clay are for crude clay only. The annual value of clay products is several times greater, but is omitted because there is only one factory. Production began in 1875.

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lying in El Dorado County just outside the county-line of Placer, made a gross yield of $1,000,000 to a depth of 1100 ft. Most of the ore in this district carries considerable silver. Pyrite and galena are common, and in places zincblende and copper sulphides occur.

Many of the Ophir mines have been typical 'pocket' producers, in which very rich ore has been found in bunches or small ore shoots. Several properties, however, show good-sized veins traceable for quite a distance on the strike and carrying fairly long shoots of low grade.

All of this district is easily accessible over good roads, with broad-gauge railroad stations one to four miles away at Auburn, Penryn and Newcastle. The mines are in the deciduous fruit belt at elevations below 1000 ft. and water and electric power are available nearby.

All of the streams draining this granitic area were rich in placer gold. Auburn Ravine, credited with being the site of the first placer discovery in the county; the former and present courses of North Fork of American River, and smaller streams, were all prolific producers. Placer mining in this lower section has been revived since the price of gold was increased, with two bucket dredgers lately installed east of Loomis and a number of dragline outfits in operation near Lincoln.

Mines in the 'Mother Lode' Formations.

In the counties south of Placer, as far as Mariposa, the larger quartz mines are found along a distinct fault zone which runs about parallel to the main axis of the Sierra Nevada, north of northwest usually, and traverses, superficially at least, a series of weak rocks or contacts. These rocks, notably the Mariposa (Jurassic) slates and the greenstones which lie on both sides of them, enter Placer County at its narrowest part opposite Spanish Dry Diggings and extend to the north county-line near Colfax. The structural conditions which made the Mother Lode mines farther south have been dissipated in a great number of small fractures in northern El Dorado County, and in these rocks in Placer County as well, mineralization has been sporadic. The eastward slope of the granitic batholith which produced the mines of the Ophir district is no doubt buried at a great depth under the Mariposa slate in this county. There is another unfavorable condition—the absence of structurally strong but chemically permeable dikes or sills in the Mariposa rocks to form firm walls for the open fissures in which ore deposits might form. It is not surprising that most of the mines there are of the seam type, so common in northern El Dorado County. The only important producer in this belt has been the Rising Sun Mine, but it is interesting to note that its vein outcrops in a contact zone of diabase, serpentine and slate almost at the edge of a small batholith of gabbro.

The Serpentine Belt.

The principal outcrops of peridotite or similar rocks and the serpentine derived from them which, in the counties to the south follow the course of the Mother Lode, lie farther east in Placer County, running north from Volcano Canyon (just east of Forest Hill), to Towle and thence through Nevada and Sierra counties. These rocks are prominent at Alleghany, a district of rich 'specimen' ores in Sierra County. Numerous good-sized specimens of crystallized gold have been found along the contacts of this intrusive rock. It is likely that much of the gold which fed the lower courses of the rich ancient channels under the lava capping of the Forest Hill ridge was derived from such deposits. In these areas, the serpentine and the adjoining schists or gabbro have in places been subjected to intense alteration by alkaline solutions, giving rise to the formation of large bodies of ankerite or similar carbonate rocks, often stained green by mariposite. While the most of such rock may carry a little gold, it seldom makes ore. Gold is at times found in the seams or 'floors' in coarse crystallized pieces as at the Garbe and de Maria Mine in Lady's Canyon or it may occur in a vein along or near the wall, as at the Three Queens Mine, in Volcano Canyon.

East Belt.

East of the serpentine and covering most of the remainder of the gold-bearing area, except where mantled by volcanic flows, are the Carboniferous rocks called the Blue Canyon formation. These are black clay-slates and quartzite principally, with many layers of interbedded igneous rocks which accompany the quartz veins. Quite a large number of scattered mines have been worked in this region. The only pronounced groupings of veins are four miles southeast of Towle and in the Canada Hill section. These veins generally strike north to northwest. The Pioneer, Herman and American Bar have been the most important mines of this type.

Alabama Mine. Alabama California Gold Mines Company, 834 Central Building, Seattle, Washington. William Anderson, president and superintendent, Box 155, Auburn, California. This mine is about a mile east of Penryn on the Williamson property and the surface is covered by a bearing orchard.

The quartz veins of this district, known in early days as Stewart's Flat, were first worked in the 1850's. Two quartz mills were in operation in 1857 and 1858 and a third was built in 1862. No details remain of the results of this early work. The Alabama Consolidated Mining Company was active in the 1880's. The quartz claim which is now the nucleus of operations was patented about 1894 as the American Mine. The mine had lain idle over 40 years when George Phillips and associates began work unwatering it in 1932. The shaft was found to be 200 ft. deep, but comparatively little ore had been mined. The first trial millruns were so encouraging that a 10-stamp mill was erected and stoping was started. The operation was creditable and almost unique in that the working partners reopened, equipped and began production from the mine with their own funds and labor, without recourse to a stock issue.

In February, 1934, after doing further work, Wm. Anderson took charge for the present company. Ten stamps were put in operation in May, 1934. Early in 1935, flotation cells were installed and July 15 ten more stamps were put in operation. About 65 tons of ore was being milled daily at the end of July with a total crew of 26 men.

The vein stands nearly vertical and strikes nearly north. All work late in July was being done upon and in stopes above the 200-ft. level, which follows the vein 565 ft. south and 480 ft. north of the shaft. In the north face, vein was then 55 inches wide, of quartz banded in layers an inch wide with thin seams and some larger irregular bunches of oxidized sulphide. A pronounced layer of quartz 10 inches wide, carrying considerable oxidized sulphide, lies on the hanging wall. On this end the vein is only slightly flexed and offset in two or three places. At the south face the vein is split into footwall and hanging-wall seams and near here the dip flattens to 46° W., with 4 to 5 ft. of quartz. The horse of rock on the west is a darker phase of the granitic rock, probably a gabbrodiorite or gabbro, that on the east being lighter and more decomposed. Not enough work has been done at this face to show whether this is a contact of two igneous rocks or one of those cases of segregation of basic constituents from a parent magma. For the entire distance of 1045 ft. the vein is of good width, 2 to 7 ft. of quartz with 2 to 4 inches of gouge on each wall. Down to this depth the ore is oxidized. The best pay is reported in the layers of quartz varying from 2 inches to 1 ft. wide, found on each wall. Average assays are reported over $9 a ton. Considerable ore is already broken and blocked out above the 200-ft. level. From 50,000 to 60,000 gallons of water is pumped daily. Ore is hoisted in buckets.

After being broken, ore goes by belt conveyor to the mill bin and to 20 stamps, which crush through 30-mesh screen. From the plates, pulp passes to five Fagergren flotation cells, size 28 by 7, run by 1½ h.p. vertical motors, 1200 r.p.m. From the last cell tailings go over two concentrating tables. Pine oil and Zanthate 25 are used in flotation. Concentrate forms about one-half of 1% of the ore, and contains pyrite, and a little galena, argentite and telluride. There are small amounts of bismuth, antimony and arsenic reported. Concentrate is said to contain about 9 oz. gold and 120 oz. silver per ton.

For 1935 to October, the company reported milling 11,000 tons of ore which yielded a reported profit of $1 a ton.

Alameda Mine contains one claim and adjoins the Annie Laurie on the southeast. Geologically, it is similar to and an extension of, that mine. Most of the work upon it was done by placer mining, which was facilitated by the steep slope toward American River and decomposed condition near the surface. The last production was between 1902 and 1908, when irregular work on a small scale yielded a few hundred dollars a year, part of it evidently from quartz ore. The formation was soft and decomposed to a depth of 25 to 40 ft. In 1909, *Begole Mines Syndicate* of Boston had an option on this and the adjoining Annie Laurie and prospected both of them, but are not known to have made any production.

American Bar Quartz Mine in Sec. 33, T. 14 N., R. 11 E., 3½ miles by road and trail from Michigan Bluff has had several periods of activity since 1895, when the first mill was built, and has been mentioned in earlier reports, the last of these being that for 1922. The mine occupies the slope on the north side of American River and has been worked through a series of adits, the lowest of which is near the river level. The country rock is Carboniferous slate with many interbedded layers of igneous material probably deposited as dikes or sills, with strike similar to the slate but dipping at a small angle to it, at least locally. This igneous rock carries much pyrite and weathers a rusty red. A good exposure of the rock series a few hundred feet northwest of the mill shows a system of alternating layers of slate, quartz veins and rusty dikes, striking N. 20° W. and dipping northeast. Some of the veins are 1 to 3 ft. thick here.

The principal production in late years was from 1923 to 1925 inclusive, when American Bar Quartz Mining Company milled over 10,000 tons of ore which averaged over one-half an ounce of gold per ton. The sulphide was surprisingly low grade for such ore. In 1934, *Industrial Engineering and Equipment Corporation* reopened the mine and milled with 10 stamps at the rate of 30 tons a day for a short time, on lower grade quartz. In 1935, the uncovering of better grade ore was announced, and milling is reported as having been resumed. The best ore in 1924 was reported from 2 to 5 ft. thick and 170 ft. in stope length, probably the largest part of the orebody. In 1934, Level D, the deepest adit in ore, was reported 820 ft. long and 280 ft. deep on the dip of vein.

A 20-stamp mill has a capacity of 65 tons a day.

Annie Laurie Mine comprises six unpatented quartz claims 4½ miles south of Colfax on the Forest Hill road. R. H. Young, Colfax et al., owners. G. Nissen worked the decomposed upper part of deposit before 1900 by placer mining. A Huntington mill was installed in 1901. The operation of the mine by Young and by different lessees has been intermittent, but there has been a small production reported nearly every year for the past ten years.

The deposit is a dike lying between schist walls. To a depth of about 25 ft. the dike is oxidized, soft and iron-stained. Below that, it shows as a dense, fine-grained black rock, filled with narrow seams of quartz and carrying considerable disseminated pyrite. Several short adits have been run, and also an open cut which was 550 ft. long, 25 ft. deep and 8 to 15 ft. wide at the bottom in 1931. From here, after dropping through a raise, the ore was hand trammed for about 670 ft. and dropped down a chute on the east side of the hill to the mill. The dike strikes north and dips steeply east, and where the greatest width had been mined north of the raise, the hanging wall had apparently not been reached.

Formerly 10 medium-weight stamps were used for milling. Recently some other equipment, of sufficient capacity only for testing purposes, has been added. Riley Self and associates have had a lease and option during 1935 and have done a little work.

Australian Mine. East of the Copper Bottom drift mine, in Iowa Hill district. No work had been done on this ground for many years previous to 1927, when Delmue, Underwood and Mathews Brothers took a lease upon it and mined a few tons of ore from the two adits. This was crushed in the 5-stamp mill and gave fair returns, but evidently the amount of ore indicated did not give sufficient encouragement for the lessees to continue work.

Beauty Mine. Located at Canada Hill 24 miles by road from Forest Hill, and described in past reports under the title *Canada Hill Mines.* After the 1927 report was written, a 10-stamp mill was erected and about 1800 tons of ore was crushed in 1927 and 1928. In January, 1934, Beauty Mines Consolidated, Limited was given a permit to sell stock. Although surface improvements were reported in 1934, the mine was idle late in 1935 and so far as could be learned little new work had been done underground. The mill was operated as a custom plant for a short time in 1935 to crush ore mined on other claims nearby, belonging to other owners.

Big Oak Tree Quartz Mine. Lot 50 in S½ of Sec. 33, T. 15 N., R. 9 E., adjoining the Rising Sun Mine on the south. It was originally located as the Milford, but no history of it under that name remains. It was relocated in July, 1883, under the present name and was worked until May 7, 1888, when closed by litigation. During this lawsuit, it is said evidence showed that a profit of $30,000 had been made between 1883 and August, 1887. Little, if any, later work was done until *California Premier Mines Corporation* produced some ore in 1924 and 1926; *Paramount Mines Corporation* also reported some production in 1931. The last ore was reported as yielding an average of nearly 0.6 oz. of gold per ton.

The Big Oak Tree vein is about parallel to and 320 ft. south of the Rising Sun vein and lies between diabase walls with gabbro nearby in the footwall. The strike is N. 80° E. and the dip nearly vertical. The ore is said to have averaged $28 a ton. An average width of 18 inches is reported, with a width of 10 inches in some of the deeper faces.

There are two shafts, the deeper being 175 ft. on 65° incline, with three levels at 77, 108 and 165 ft. No. 2 and No. 3 levels are each reported to have been driven nearly 500 ft., encountering faults on the east, one of which throws the vein 18 ft. south at about 225 ft. east of the shaft. On the west, the vein turns to the northwest. From No. 3 level, west drift, a winze has been sunk and No. 4 and No. 5 levels turned from it at 223 and 287 ft. A length of about 100 ft. was stoped just east of this winze and up to No. 3 level.

Work has recently been begun on this mine.

Big Pine Mine. (*See T. W. A.*)

Big Shady Group of six claims and mill-site lie south and west of the Annie Laurie. David Bauer, R. F. D., Colfax, owner. One adit has been run over 300 ft. and another 80 ft. to prospect a ledge which the owner claims has yielded assays of $3.50 and $5.85 a ton across a width of 20 ft. There is a 1-drill compressor, and rail and pipe have been laid in one adit.

Black Hawk Mine is on the North Fork of American River, four miles southeast of Towle by trail. As mentioned in the report for 1927, it was reopened in 1927 and equipped with a second-hand mill of 10 stamps. In 1929 and 1930, Black Hawk Quartz Mining Company reported crushing a total of 110 tons of ore. In 1934, several hundred tons more was crushed, and a road was built.

Black Oak Mine. In SW¼ of Sec. 35, T. 14 N., R. 9 E., 3½ miles by road southeast of Weimar, on the railroad and state highway. A. J. Rupp had the property under lease for three years past, but recently (June, 1935) lease has been transferred to *Gold Chain Mines Company,* H. B. Palmer, local manager. On July 17 a crew of six men were preparing to resume work at the upper adit and sink a shaft just north of its portal. Other land adjoining on the south for a mile and a half is also reported under lease to this company.*

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* This company has lately (1936) given up its lease and Rupp has resumed possession of the Black Oak.

Although mapped as part of the Mariposa (Jurassic) formation, the country rock shows none of the common characteristics of the Mariposa slates in the recent workings (south adit). It resemble the Carboniferous rocks, being hard and imperfectly slaty. Fossil evidence is lacking. The vein swells and pinches, having a maximum width of 18 ft. but closing down to a few inches in places. It strikes about N. 10° W. and dips east at an average angle of 52°. The footwall is a hard dike mineralized with fine-grained disseminated pyrite and traversed by quartz seams.

The vein has been prospected and mined through shallow adits for a length of 1500 ft. On the north end it is said to be faulted 40 ft. by a cross vein. The old lower adit was started just south of this crossing and was run on the vein for 1000 ft. southward. It is claimed that in this distance two ore shoots 600 and 310 ft. long, respectively, and separated by 80 ft. of barren ground, were worked. Although the mine is claimed by the operators to have been an important producer, no official record of the output is available.

The upper or south adit follows the vein 528 ft. farther south, gaining a vertical depth of 130 ft. at the face. Several small stopes have been worked above it, the Moulton ore shoot having been mined to a maximum width of 12 ft. Over one-half of this adit is said to show ore, with the vein having an estimated average width of 4½ ft. Just outside the portal of this adit, is a shaft 23 ft. deep, from which a drift 120 ft. long was run. A crosscut from this near the shaft shows the vein in the form of a stringer lead 18 ft. wide, reported by Rupp to assay $9 a ton. Another crosscut 38 ft. south is reported to assay $5.60 across a width of 5½ ft.

There is a 5-stamp mill with one concentrator but if plans are carried out a ball mill and flotation cells will be installed, as over two-thirds of the gold in samples taken near the face of the upper adit is in the sulphide. A limited amount of water for milling comes from the mine and from springs. There is an old style compressor run by an auto engine, a small electric generator set, shop and a few small houses on the property.

Blue Eagle Mine (formerly *June Bug*) is in the E½ of SE¼ of Sec. 18, T. 12 N., R. 8 E., just west of Eclipse Mine. Address, Hall Livingston, R. F. D. 1, Box 25A, Auburn. Being worked by a partnership.

Some of the veins of the Eclipse Mine extend into this ground, but only a little work was done in the past here, yielding about $1200 from a shallow shaft. The present work is in this shaft, 135 ft. deep on 45° incline. Late in July, 1935, a level had been turned at 120 ft. and the west drift was 50 ft. long. This shaft was sunk on the June Bug vein which strikes south of west and is reported to average 18 in. wide so far, and to give assays of $10 to $15 a ton. A north-striking vein is said to yield lower grade material, of which some has been milled by the present operators. So far the gold from this was found entirely associated with sulphides, but free gold is reported in the drift.

A small single-drum hoist is operated by an automobile engine and a water wheel runs the pump. Power for the mill is furnished by a 25-h.p. Fairbanks Morse Y-type engine. A Straub 10-stamp mill and small ball mill crush ore. Two cuts of concentrate, the first and richer carrying gold, galena and pyrite, and the second a lower grade concentrate, are taken from the Overstrom concentrator. The table tailing passes to two home-made flotation cells, each using a one-third h.p. electric motor.

Bonnie Bee. South of Bear River, and 2½ miles west of north of Blue Canyon. Reported to have three veins, 4, 6, and 12 ft. wide, in the Blue Canyon (Carboniferous) slate. Veins strike northwest and have nearly vertical dips. The canyon permitted prospecting by adits, one reported as being 500 ft. long in 1903. In that year, a small mill was put in operation, and a few hundred tons of low-grade ore was crushed. There was also a small production in 1905, since which time there is no further record of activity.

Centennial Mine on Duncan Hill, two miles southwest of Auburn, is an example of a type common in the district. The vein is about 30 inches wide, in amphibolite schist, but pinches down at intervals. It strikes N. 80° W. and dips 70° south. The ore occurred in small rich shoots, from 2 to 50 ft. long, the formation of which appeared to have been influenced by 'iron crossings,' the miners' term for zones rich in pyrite and chalcopyrite in the amphibolite schist. Ore was mined in 11 or 12 shafts, the deepest 180 ft. After this, adits were run from each end of the claim, one 700 ft. long and the other 900 ft., connecting a few feet apart vertically at one of the shafts. The plan was to mill the entire vein, but this was unsuccessful. The total production was $150,000 or more. The estimated value of ore in the rich shoots was $8 to $12, but the vein as a whole is low grade.

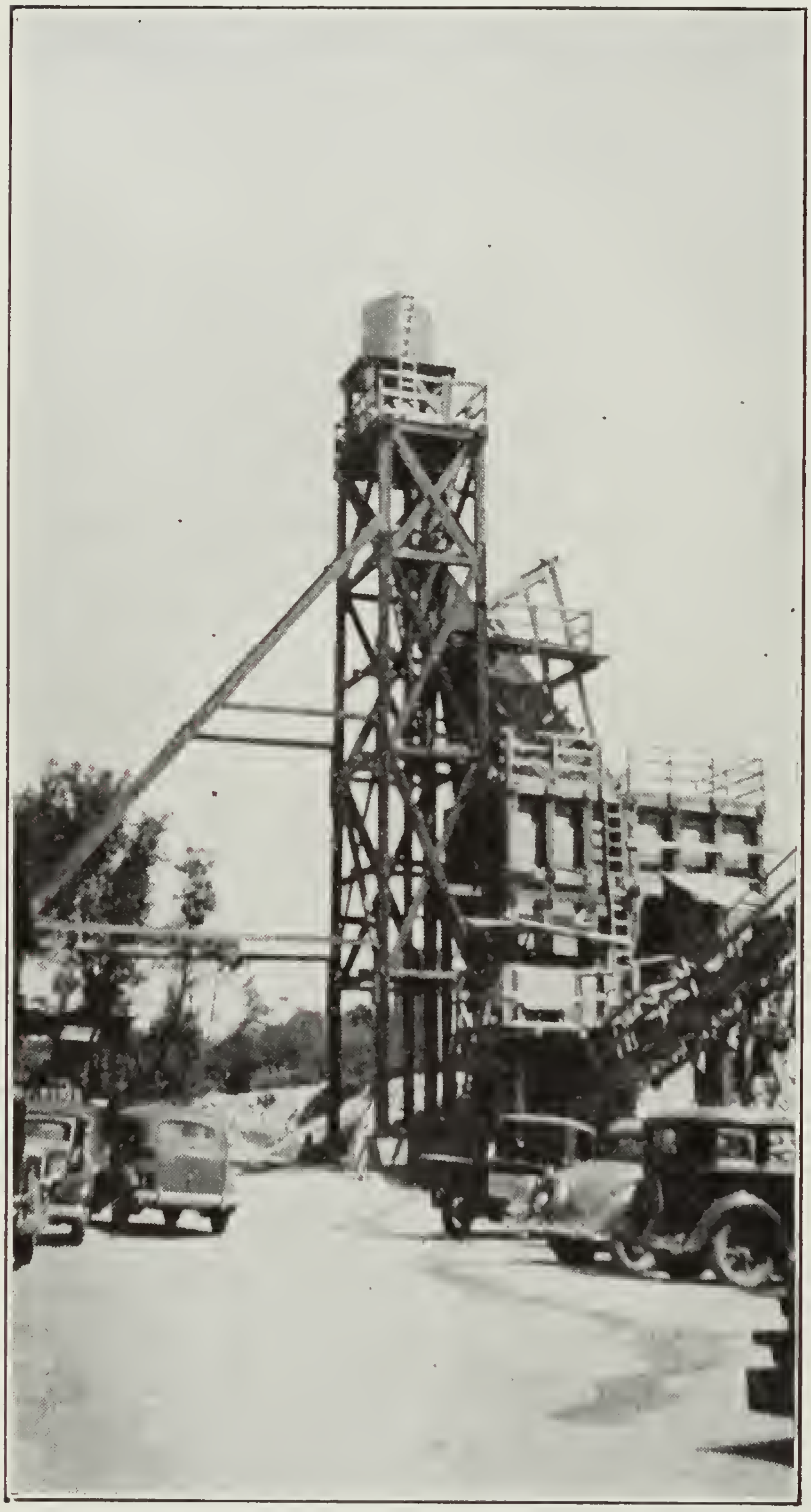
In 1929, some of the rich ore that occurs in places in this vein, was found and stimulated further work. A few hundred tons of ore was milled, but gave low returns, on the average.

In 1931, *Paramount Gold Mines Corporation, Ltd.,* took this claim and the adjacent Conrad under lease and option to purchase. The plant was placed and most of the work was done on the Conrad, but a crosscut was run to the Centennial. In 1931, the claim was locally credited with the production of a few thousand dollars from a small lot of good ore milled at the Rising Sun mill, near Colfax.

Central Mine. In the canyon of North Fork American River north of the mouth of Humbug Creek seven miles by trail from Towle. The vein strikes northwest in the Blue Canyon (Carboniferous) slates and schists. It was worked in a small way between 1897 and 1903, producing a few thousand tons of ore from an open cut and from stoping above an adit level driven as a crosscut about 140 ft. then drifted on the vein about 200 ft., so far as could be told at time of visit, when caves from the old stope partly blocked the adit. A length of about 75 ft. and from a few inches to 7 ft. thick, had been removed in the stope seen. The ore formed a lens of solid quartz, standing nearly vertical between walls of interlayered grey altered igneous rocks and black slaty schists, typical of the Carboniferous in the Sierra. The walls are hard and stand well, requiring little timber. Ore was reported low-grade.

Lately reported taken over by *American River Mines Company* in connection with the Dorer Mine, adjoining, and nearby placer mining claims.

Chicago Mine. In Secs. 35, 36, T. 12 N., R. 7 E., 1¼ miles east of Penryn. Lessee with option to purchase, *Auburn-Chicago Mining Company,* 3443 Wilshire Boulevard, Los Angeles, c/o Auburn Auto Sales Corporation. A. N. Sweet, manager. The *Elizabeth* on the south and *Mary Len* claim on north of Chicago, are also under option.



Head frame, Auburn-Chicago Mine, near Penryn.

The Chicago Mine was worked to a depth of 300 ft. in the 1880's. The Elizabeth was worked in the 1860's and both were producers. No reliable record remained of this work, and even the depth and extent of the mine openings were uncertain. The old Chicago shaft, No. 1, is 430 ft. north of present working shaft called No. 2, which is 110 ft. north of the north line of Elizabeth claim. No. 2 shaft is vertical, 405 feet deep, one-compartment and manway. The 110-ft. level has drifts 150 ft. north and 325 ft. south. On the 300-ft. level, drifts were run by this company 420 ft. south and 430 ft. north to No. 1 shaft; thence northward, the old drift was reopened 550 ft. On 400-ft. level drifts 360 ft. south and 430 ft north. A sub-level at 360 ft. has a short drift and raise to 300-ft. level. From 400-ft. level, two raises reach 300-ft. level, one a little north of No. 1 shaft, the other 175 ft. south of No. 2. A winze has been sunk 100 ft. below the 400-ft. level. Nearly all the work has been directly upon the vein, including the shaft.*

The vein stands nearly vertical and strikes generally about N. 20° W. except where bent or faulted. It ranges from a few inches to 3 ft. wide, but is as a rule between 1 and 2 ft. wide in the ore shoots. The widest parts are reported low-grade and are composed of solid white quartz. There is little gouge and the granodiorite walls are unaltered and hard close up to the vein so that little timber is required. The best ore is reported to have zincblende in small amount, and galena and pyrite are common, though the total average sulphide content is small, well under 1%. About 40% of gold has in the past been saved in the concentrate. The average yield of ore during the first year of milling was nearly $17 a ton. Average assay widths ranging from 1.1 ft. to 1.85 ft. show wide variations in gold content but general high averages. The vein in the winze, sunk 100 ft. below the 400-ft. level, is reported to show an average width of 1.85 ft., an average assay of 1.38 oz. gold, and a block of ore stoped from it 32 ft. long by 100 ft. deep is claimed to have yielded one-half ounce gold per ton.

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* In April, 1936, the 550-ft. level had been run 125 ft. north and 625 ft. south, and A. N. Sweet stated a length of 190 ft. and average thickness of 18 inches gives good assays.

On the south, a fault cuts off the ore about 220 ft. from the shaft on the 400 ft. level. The south part of vein is set over some 7 ft. horizontally to the west, looking south. On the 300-ft. level south a fault of more pronounced character appears to be associated with a change of the wall rock from granodiorite toward gabbro, with a black gouge. Secret Ravine probably follows the surface trace of this faulting. Gabbro outcrops about one mile southeast of the mine. There are a number of other flexures in the vein, and the small bodies of higher grade ore are quite possibly associated with obscure sheeted or shear zones in the wall rocks.

Hoisting is done in buckets by a 25-h.p. electric hoist. Separate chutes receive ore and waste. From the grizzly, undersize goes to a bin and oversize to a 9 in. by 16 in. jaw crusher. A 4½ ft. by 6 ft. ball mill has replaced the rod mill formerly used. Pulp from it passes to a concentrating table, where a high cut is made for amalgamation. A classifier takes the table reject and delivers fines to five flotation cells, returning coarse to the mill. Flotation concentrate and tailing from the clean-up barrel are sent to a smelter. The capacity of mill is about 65 tons a day and 65% to 70% of the gold recovered is saved by amalgamation.

Conrad Mine. The claim covers about 1200 ft. along the vein, and like the Centennial was worked at times from 1868 to 1890. The vein dips 40° to 50° south and is parallel to the Centennial. It averages about 2 ft. wide but pinches down at places. It lies between amphibolite walls.

The mine has been worked through a tunnel 784 ft. long (180 ft. below outcrop) which is open all the way, and shafts have been sunk from the surface and raises put up from tunnel level wherever pay was found. There is a winze about 60 ft. below tunnel level, but it is said to be off the pay shoot. The largest pay chimney was found 30 ft. above the tunnel and yielded $15,000. The property is credited with about $50,000 production.

The ore resembles that in the Booth more than the Centennial, and is said to run from $4 to $8 a ton away from the rich chimneys.

In 1931, this and the adjacent Centennial claim were taken under lease and option by *Paramount Gold Mines Corporation, Limited.* A shaft was sunk on the Conrad claim. This was 225 ft. deep on an inclination of 45°, at time of visit. It was later reported to have been sunk to 300 ft. It crosses the old adit at 125 ft. inclined depth.

The mine plant includes a wooden headframe, single drum hoist with electric motor, air compressor and 100-h.p. electric motor, and drill sharpener. The milling plant comprises a Chilean mill of 40 to 50 tons capacity, 40-h.p. motor, small gyratory crusher and motor, and three amalgamating plates. Very little ore was crushed.

John K. Wright is reported to be in charge of these claims since the death of E. C. Klinker, former president of the company.

Crater Hill Mine was one of the principal producers of the Ophir district. Although at times credited with a total yield of $750,000 the writer has been able to find definite figures for only a little over half as much. It was actively worked in the 1870's by *St. Patrick Mining Company,* with a gross output of $146,334 from 1873 to 1875, inclusive. Again in the early 1880's there was considerable production. The mine was closed down in 1884, after the workings had reached a depth of 800 ft. All ore found had been stoped out from the 800 ft. level to the surface. In 1907, W. P. Hammon began unwatering the mine and spent considerable time in exploring the old workings, but is said to have done little new work, except running a crosscut 180 ft. on the 800 ft. level, and drifting ahead a few feet from some of the old faces. A 10-stamp mill was erected, but had crushed less than 2000 tons of ore when the property was closed in 1910 and has been idle since. The underground work extended for a maximum length of 700 to 800 ft. on the stike of vein, and stoping was done principally on the east of the shaft after passing below the 300-ft. level. The principal or hanging wall vein lies between granodiorite walls, strikes nearly east and dips 45° south. J. H. Crossman, the superintendent for the St. Patrick Mining Company during the mining down to the 300-ft. level, described it as having an average width of 20 inches; but the width varies from a few inches to 3½ ft. in places. The principal ore shoot was triangular in vertical section, increasing in stope length from 40 ft. near the surface to 203 ft. at a depth of 212 ft., and much longer at 312 ft., where the vein was reported 2½ ft. thick. The ore raked east at about 45°.

At the surface the footwall ledge lay 32 feet north of the hanging wall vein and was reported to have been of good grade when worked in early days; no details remain to indicate much later work on it. There are a number of other veins and stringers upon the property, but none of these is known to have been productive, except on and near the surface which was extensively mined in the early days. The two productive veins were connected in Crossman's time by a crosscut at the 150 ft. level, and a shaft on the footwall ledge was used for pumping, there being steam engines at both shafts, 135 ft. apart, supplied from one boiler. The footwall vein supplied some ore that yielded $19.13 a ton, while the hanging wall vein gave $31.52 in gold a ton in the upper levels. Sulphide apparently carried about $100 a ton and formed about 4% of ore. Of this gold content, about 60% was saved by working in pans.

Daniel Webster Mine is 1½ miles northwest of Michigan Bluff. It was worked 30 to 35 years ago, yielding small amounts of gold from shallow workings. The veins occur on a placer mining patent, and some seam mining was done. Later, Daniel Webster Mining Company produced a little quartz gold (1921–1922). From 1931 to 1933, *Black Bear Consolidated Mining Company* had a lease on the ground and reported producing about $4000.

Dairy Farm Mine. Dairy Farm Gold Corporation, Box 326, Lincoln, California. M. C. Lake, president. E. R. Hathaway, superintendent.

This was one of the gossan-capped mines of the foothill copper belt which was first worked for the gold and silver found in the oxidized zone. It is in the S½ of Sec. 27, T. 14 N., R. 6 E., 8 miles northeast of Sheridan. The above company had a lease and option on 77 acres.

Open-pit mining of gold-bearing gossan ore at Dairy Farm Mine, 1935.

Surface plant at Dairy Farm Mine, near Sheridan, 1935. The cyanide equipment has recently been removed.

From 1904 to 1906 inclusive and from 1913 to 1918, this mine produced considerable copper, gold and silver. In the later years the cyanide plant that had been erected to recover gold was not used, and sorted ore was shipped out to a smelter over a narrow-gauge railroad which connected with the Southern Pacific main line north of Sheridan. The yield of the three metals varied greatly, ranging from $1.25 to over $4 a ton in gold, from a few cents to $1.70 in silver, and from less than 1% to 15% copper, the latter probably coming from picked ore, not mined by the shrinkage method usually followed. Work stopped in 1918 when the price of copper fell, and the mine lay idle until the last company began operation in 1933. The reduction plant began running in December, 1933, on the remaining gossan ore, and was in operation about 2 years.

In different parts of the open cut, where mining was done with a Thew three-fourths cu. yd. shovel, the textures and grades of ore varied so widely as to affect the success of the treatment. In spots, a soft, friable gossan composed principally of iron oxides and breaking up into slimes and fines was found. Elsewhere, the ore was hard enough to yield a satisfactory coarse product on crushing. Again, the amounts of free acid, silica and clay varied in different places, some old fills and dumps being especially high in acid. To give as nearly uniform a product as possible for the cyanide plant, the shovel was moved about to dig the various kinds of material and a system of stockpiling was used from which mill feed could be drawn.

Ore was delivered in trucks to the bin and was broken in a 9 in. by 36 in. Wheeling crusher, screened through a 3 ft. by 4 ft. Colorado impact screen and oversize crushed in 26 in. by 15 in. rolls. It was given a preliminary washing with water for 16 to 24 hours to remove free acid before cyanide treatment. There were six leaching tanks, four of them 25 ft. by 8 ft. and two 25 ft. by 10 ft., each loaded with from 100 to 125 tons of ore. From 8 to 12 lb. of –10 mesh Auburn Chemical lime was used per ton of ore. Strong, weak and barren solution storage tanks carried solutions containing from 1.2 lb. to 0.6 lb. of sodium cyanide per ton of solution. The charge received strong, weak and barren solution washes in turn followed by a final water wash. Solutions were moved ahead as they increased in gold content, finally going to the new charge. Four sump tanks each had a pump operated by an automatic float switch. From the gold solution tank, pregnant solution went to Merrill-Crowe precipitation equipment and solution was then returned to the circuit by way of the barren solution storage tank. The cycle of treatment required six days. In July, 1935, about 100 tons a day were handled, with a total crew of 19 men. Recovery was reported to be from 80% to 90%.

The open cut where mining was going on was about 600 ft. long and 30 ft. wide at the bottom. It was about 125 ft. on the dip from the top of footwall, or 90 ft. vertically to the top of the sulphide zone. Mineralization was said to extend into the hanging wall 65 ft. The old mine workings, where sulphide ore was mined, extended about 500 ft. below. The footwall was 'porphyry' and hanging wall, greenstone (amphibolite schist). The sulphide ores occurred in lenses reported to have been 10 ft. to 60 ft. wide, and this accounts for the variations in the character of material mined in the open cut.

This mine was closed down early in 1936, and the cyanide plant was sold and removed.

Devon Mine. California Mines, Incorporated, and four subsidiary promotions reported to be based on prospects south of Weimar and on the west side of North Fork of American River, on the J. A. Graves and Livingstone and Elder holdings. Recently the company relinquished at least part of its holdings, which are now (November, 1935) being prospected by other parties.

Dorer Mine. In the canyon of North Fork of American River, 2½ miles southeast of Shady Run and north of Humbug Bar. The vein, striking northwest in the Carboniferous schists, was mined through adits run between 1888 and 1904. Pay was said to occur over a length of 150 ft. and reported width was 4 ft. The production ranged from $1,100 upward annually for several years. A 10-stamp mill was used, and ore was delivered to it by an aerial tram.

The Central claim adjoining, was worked during the same period and produced about the same grade and quantity of ore.

Late in 1934, these claims were reported as having been taken over from Lee Dorer, together with some old placer mining ground at Humbug Bar, by *American River Mines Company.* Work on both quartz and placer was going on in 1935 and it was expected the 10-stamp mill would be started during the summer.

Drummond Mine is about 10 miles by road from Forest Hill, on a long ridge between tributaries of North Fork of Shirttail Canyon, and extending into the canyon. It contains 320 acres, patented. The early operations are described in former reports. The work was done principally between 1889 and 1899 by C. F. Reed. No mining has been done for a long time. The record of production, given only in round numbers, indicates a total yield of between $150,000 and $200,000.

The country rock is amphibolite schist, locally called 'diorite.' The Drummond or hanging-wall strand and Lynn or footwall strand of the main vein produced most of the ore milled, while the Eclipse, a 'pocket lead' near the north property-line, is said to have yielded considerable 'high grade.' The Wolford is another pockety vein that made some production. The Drummond and Lynn strike N. 60° W. and dip steeply northeast, while the Eclipse and Wolford, regarded as spurs of the first, but not yet so proven, strike east. The widths of the veins vary from 6 inches to 18 ft. of quartz according to J. B. Hobson, and the width between walls of the main vein is in places 30 ft. The older mine workings are mostly inaccessible.

In the No. 1 tunnel, a block of ore 100 by 100 ft. and 3 to 5½ ft. thick was stoped by Drummond, the discoverer, and Hobson. To the east the so-called 1st level was run 490 ft. In this, the Lynn strand was stoped 330 ft. long and Drummond strand 70 ft. long by 100 ft. deep. No. 3 adit or '2d level' is only 50 ft. deeper, and 1000 ft. long with stopes 40 and 110 ft. long. The '3d level,' reached by a winze 70 ft. below No. 3 adit, is 350 ft. long, with a stope 190 ft. long and reported 5 to 8 ft. wide. About 350 ft. vertically lower, an adit was afterward run 2000 ft. as a crosscut, drifts were run 150 ft. west and 450 ft. east, and a crosscut was advanced 190 ft. from the face of the west drift. This adit is still open. Some ore is claimed to remain in the old, upper workings. All buildings except one cabin have been burned. A deeper tunnel site is available farther down the canyon.

Eclipse Mine. In NW¼ Sec. 17, T. 12 N., R. 8 E., one-half mile northeast of Ophir. Lessee, *Grimshaw Properties Company,* R. F. D. 1, Box 22, Auburn. V. A. Van Horn in charge.

This mine was a producer from the early 1880's at intervals until 1906. From 1889 to 1906 the recorded output was about $60.000. The record of earlier yield is not available, though rich ore is said to have come from the Morning Star vein on or near the south line in 1882 or 1883, and the Eclipse claim is mentioned as having been officially surveyed in 1872, covering a length of 2475 ft.

Seven or eight veins or spurs have been mapped by Lindgren on this property. They strike generally a little north of east and dip south usually 30° to 45°, except the Morning Star vein which strikes nearly north and dips east, up to the Good Easter or Eclipse vein. The walls of these veins are both granodiorite, with a streak of soft schist on the hanging wall which had to be removed in mining the two veins named.

The old shaft is 530 ft. deep on 45° incline, with levels called 200-, 300-, 400- and 500-ft. Down to the 300-ft. level the ore has been stoped over a reported length of 750 ft. The Morning Star vein is reported to have been the principal one worked. It is said to strike the Eclipse vein about the 300-ft. level, and to lie on its hangingwall to about 350 ft. deep. Below there, the Eclipse vein steepens and the two are 40 ft. apart at 400-ft. level. The later workings include 520 ft. of drifting on Morning Star vein, a 40-ft. crosscut and 150 ft. of drifts on Eclipse vein on 400-ft. level, a drift 90 ft. east on Morning Star vein on 500-ft. level, a 70-ft. raise from 400-ft. to 300-ft. level about 400 ft. east of shaft, and two small stopes. One of these about 40 by 40 ft. and extending from 350 ft. deep to within 10 ft. of 300-ft. level, and one about 50 ft. high above the 400-ft. level are the deepest. The vein is reported to be narrow and disturbed between the 400- and 300-ft. levels. The veins vary in width from 6 ft. down to a few inches.

On the 500-ft. level the gold is said to be nearly all in the sulphides, which are pyrite, galena, and argentite and form up to 2% of ore, according to V. A. Van Horn, who was in charge of unwatering and prospecting the mine in 1933. Old stopes were found as much as 16 ft. wide. The ore carries up to 9 oz. silver per ton and gold fineness is 664 to 671. In 1902 the average yield per ton was $7.54.

The surface plant comprises a hoist with a depth capacity of 1000 ft., run by an automobile engine; Gardner compressor (one drill capacity, with a 20-h.p. electric motor; a 10-stamp Straub mill said to have a daily capacity of 9 tons, taking one-half to three-fourths in. feed, and run by a 7½-h.p. electric motor, and one concentrator. The mine was idle when visited July 27, 1935.

Elizabeth Mine. Adjoins Chicago Mine, east of Penryn, and under lease to same company. The Chicago shaft No. 2, through which operations are now going on, is only 110 ft. from the Elizabeth north line, so that the south drifts are in the Elizabeth ground.

In addition, work was done upon this claim in the 1860's when a shaft is reported to have been sunk 120 ft. deep and drifting produced ore which was crushed in a 5-stamp mill, giving a reported yield of $15 a ton.

Ferrier Diggings (*Johnny Rafael Mine*). L. G. Embree, Forest Hill, lessee in 1935. This is the next claim north of the Garbe & de Maria, on Lady Canyon on the steep north side of the canyon of Middle Fork of American River. Like the latter, it has been a producer of specimen ore, some production having been reported nearly every year since 1919, besides that previously taken out by Ferrier.

The principal production was made by Andrew Ferrier, the discoverer, who is reported to have taken out a small fortune from the claim when he traced the source of gold-bearing clay used by neighboring miners in building a forge.

Garbe & de Maria Mine (*Dry Hill, Blue Jay*). On Lady Canyon on the steep north side of the Canyon of Middle Fork of American River. For many years this mine has been noted for occasional 'pockets' of coarse crystallized gold. At the time of visit, the workings consisted of a network of crooked drifts in the oxidized zone, on a flat seam dipping east about 15° in rock too badly decomposed to classify but probably originally intrusive in the rocks of the Carboniferous series near the serpentine contact. The operators professed to be at a loss to recognize any sure signs of 'pay.' The gold is said to occur at times either with or without manganese oxides or iron oxides; at times with quartz and again in mud-filled seams almost devoid of it. A few years ago a small stamp-mill was put on the mine to crush accumulated quartz.

Gold Blossom Mine. One of the more important of the former producers in Ophir district, and frequently described in past reports. It was among the holdings of the *St. Patrick Mining Company* in 1873 when a shaft upon it was 70 ft. deep and ore yielding $7.50 a ton was reported. By 1890, the shaft was 218 ft. deep, and the Gold Blossom and Marion lodes were being worked, supplying ore to a 10-stamp mill. The ore was reported as containing, besides free gold, a ''large percentage of argentiferous galena, zincblende and pyrites containing copper, iron and arsenic.'' Concentrate at the time was saved on canvas blankets, and cleaned on a Frue concentrator. Some sorted sulphide ore was shipped. Assays of some shipments of concentrate showed from $17.55 to $255.00 gold and from $57.04 to $75.52 silver a ton (silver $1.18 an oz.).

The principal period of recorded production was between 1896 and 1899 inclusive, when over $200,000 was produced. Although the tonnage was not definitely reported, it has been claimed that the ore milled yielded about $8 a ton, but that remaining in the mine was of much lower grade. Most of the production appears to have come from above the 400 ft. level. The main shaft was sunk 480 ft. by 1907 and little has been done since.

The Gold Blossom vein strikes a little north of west and dips south 70° to 85°, being traceable for a mile westward to its junction with the Marion spur vein, and beyond this for another half mile through the Ohio, Trio and Pacific quartz can be traced. Most of the work was done on the two veins near their junction on the westerly Gold Blossom claim, although many shallow holes have been sunk along the outcrop, and one tunnel produced ore. The vein is 2 to 3 ft. thick. The country rock is granodiorite, with a dike of diorite on the hanging wall of the Gold Blossom vein and a dike of amphibolite schist on the Marion vein.

Two mills, the last of 20 stamps, were operated on the Gold Blossom. This mill and some buildings remain at the main vertical shaft but are in poor shape.

Gold Dike Mine. H. H. Marsh, owner, 415 Mill Street, Grass Valley. John D. Leedy, lessee, 3816 Eastern Avenue, Seattle. Four quartz locations in lots 21 and 22, Sec. 5, T. 15 N., R. 13 E., in Canada Hill district 10 miles from Westville. Elevation is about 6300 ft.

The country-rock is the Blue Canyon formation (Carboniferous) showing in the vicinity quartzite and some slate with greenstone dikes. The work in the shaft, which was 108 ft. deep early in August, 1935, on a vein dipping 58° west, was just entering unoxidized rock showing splotches of pyrite and galena. The vein, as shown both in surface cuts and underground, is lenticular. The shaft was sunk on one of these quartz lenses on Gold Dike No. 1 claim. It showed an average width of about 18 inches of quartz. A level was run from the bottom of shaft 50 ft. south and 40 ft. north and both faces showed the quartz pinched, but the continuity of the vein is indicated on the surface by another outcrop starting about 500 ft. from the shaft and extending some 200 ft. southwest with a width up to 3 ft. exposed in open cuts. In the level the quartz varies in strike from N. 37° E. to N. 10° W., probably due to the entry of a dike from the west side with a strike of N. 60° W.

Gold Dike Mine, Canada Hill District.

Ore taken out in sinking the first 50 ft. of shaft was hauled to custom mills in Auburn and Nevada City in 1933, yielding a maximum of $72 a ton and an average of $34. The claims cover a length of over 3000 ft. Gold Dike claim, on the southeast side line of Gold Dike No. 1, has some pits showing bunches of quartz.

The shaft has a hoist operated by a 4-h.p. gasoline engine. Two men were working in August, 1935.

Late in 1935, some ore taken out during the summer was being crushed in the mill on the near-by Beauty Mine.

Golden West. This is near the North Fork of North Fork American River, about three miles south of Blue Canyon. The prospecting work which was done 35 years ago on a wide body of Blue Canyon (Carboniferous) slate carrying quartz stringers, is said to have included two adits and a shaft 100 ft. deep. No record remains of the results. One adit is reported to have been run 1500 ft.

Grass Ravine and *Workman veins* are in the extreme western part of Ophir district, in the SW¼ of NW¼ of Sec. 12, T. 12 N., R. 7 E. The former is about in the line of strike of the Crater Hill veins, and the latter, to the south, is nearly parallel to the Gold Blossom vein series. Both dip south and lie in granodiorite.

The Grass Ravine Mine in 1900 had a shaft which was then reported 325 ft. deep. A mill-run of 150 tons was reported to have been made from this property in 1899 at the St. Lawrence mill but the results of this run were not shown in the year's production records, and the mine name does not appear in any available mint records as a producer.

The Workman is credited with about $6000 production in 1895 and 1896.

The Grass Ravine is being reopened in 1936 by *South Star Development Company.* Early in April a depth of 150 ft. had been reopened in the old shaft.

Green Mine, three-fourths mile northeast of Ophir, is on a vein striking north of west in amphibolite schist. It is from 6 inches to 3 ft. thick, and dips south 45° to 70°. This mine was a producer of very rich ore in small amounts in the 1870's. In 1871 a small crushing plant treated some lots of a few tons of ore each, which yielded from $50 to $1,100 a ton. It was reported locally that a 2-weeks run at that time with four stamps gave a total of nearly $50,000. The shaft was sunk to 240 ft. and nothing further was recorded about it after 1873. Most of the amount mentioned came from above the 125-ft. level.

Green Emigrant Mine. This old pocket mine, which was famous in early days, is 4½ miles north of Auburn and one-half mile west of Grass Valley highway. It was found by Pike Bell on New Year Eve, 1864. Secrecy was maintained regarding its production, and no reliable contemporary record of the output existed, but Bell's son advised the writer that it had yielded $150,000.

The vein, striking northwest and dipping east in amphibolite schist, occurred as flat stringers of quartz, but on the west on a hill 6 ft. of quartz outcrops. Caved ground and old tunnel portals indicate that several crosscuts and short drifts were run on the stringers. A depth of only 25 to 30 ft. was reached. A length of over 1500 ft. was prospected and mined by shallow cuts and shafts. Pay is said to have been best where "iron crossings" and limestone met the vein.

The *Two Orphans* prospect on the north, opened deeper, showed auriferous pyrite and chalcopyrite and galena. The *Black Lead,* a former producer, lies nearby to the south.

Hathaway (*Buttes* or *Butts*) *Mine.* In Ophir district, one-half mile southwest of the old town of Ophir. The first record of operations was published in 1888, when it was said that 1500 tons of ore had been milled, yielding about $8 a ton in free gold, besides an unstated amount in the sulphides. The ore shoot outcropped at the surface for a length of over 1200 ft. with a reported width of 4 ft. Besides the shallow workings there was a shaft 210 ft. deep with a lower level. The 5-stamp mill was increased to 20 stamps in 1888, and in 1889 a large yield was reported from the tunnel operations which tapped the upper ore, as well as from the level about 200 ft. deep, where stoping extended over a length of about 700 ft. The record for the next several years is only fragmentary. Yearly production was reported from 1895 to 1903, inclusive, after which time the mine does not appear as a producer. In 1900, when the shaft was 630 ft. deep, the *Standard Mining Company* of Bodie was furnishing capital for the operations of Hathaway Consolidated Gold Mining Company which held under option the Plantz, Jacobson, Kirkland, Hathaway, Butts Extension and Eureka claims, covering 6756 ft. on the Hathaway vein. This company deepened the shaft to 837 ft. on the incline in 1902, and over 5000 ft. of drifts were run, but details of their work are lacking, although some stoping was done as far down as the 720-ft. level.

The Hathaway vein has been traced at least 8000 ft. It strikes north of west and dips 60° to 75° south, lying in granodiorite. Sheets of altered igneous rock, now amphibolite schist, accompany the vein at the Hathaway mine workings, and at the Kirkland. The vein is 1½ to 2 ft. thick in most places. It carries considerable silver, and the percentage of sulphide is 1¾ to 2%. The concentrate saved in the earlier operations yielded as much as $230 a ton. Besides pyrite and galena, there were also sulphides of zinc, copper and arsenic reported. Gold was more evenly distributed in this vein, it is said, than in most of those in the district.

Besides the work on the Hathaway claim, a shaft on the Eureka No. 1 claim is reported 280 ft. deep, with levels at 130 and 280 ft. This is on the Hathaway vein west of the Hathaway, in Sec. 13. On the east, the Kirkland claim was worked years ago through a shaft reported 200 ft. deep, but concerning which nothing is recorded. The Eureka No. 1 produced a few thousand dollars in 1902–1903, and was prospected a little in 1915. The last work on the Hathaway was in 1915 when the unwatering of the shaft was started but never completed. All the old plant was removed years ago.

Herman Mine, five miles south of Westville on the road to Deadwood, has been described in our older reports. It was a producer from 1895 annually until 1902, and irregularly from 1903 to 1915. The total reported yield was over $200,000 and from such tonnage figures as are available for the later years, the ore produced $4 to $4.50 a ton. The equipment was operated by steam power using wood fuel. Thirty stamps were used in later work.

In 1935 the 1448 acres in the holdings were reported as having been sold to James Maxfield and associates, 2619 Wilshire Boulevard, Los Angeles. In August, 21 men were employed and a cook house and club house were being built. It was planned to use steam to generate electric power and a generator was being installed. A large storage tank for fuel oil was proposed. Little work was being done in the mine. Arthur Seafang, manager.

La Trinidad (Sterrett) Mine. In Sailor Canyon south of North Fork of American River, 15 miles by trail from Cisco. The vein occurs in the Sailor Canyon formation, composed of calcareous slates which have been classified as of the same age as the Mariposa (Jurassic) slates. Granite is reported on the hanging wall side. This vein strikes northwest and dips about 45° NE., varying in width from 2 to 8 ft. Most of the oxidized ore was stoped between 1897 and 1905 through an adit reported to have been run over 1700 ft., of which 900 ft. was on the vein. The sulphide ore remaining shows antimony, pyrite, chalcopyrite and arsenopyrite besides some gold and silver. The 10-stamp mill used to crush the oxidized ore gave low returns in the last two years of work on the unoxidized rock. Later stock companies made little progress and no work has been done recently. The stamp mill was wrecked by a snowslide, and although work was started to rebuild it, this was not completed.

Live Oak Mine. In SW¼ Sec. 23, T. 14 N., R. 9 E., three-fourths mile from State Highway east of Weimar. Owner, Geisendorfer Estate. Lessees, Jones and Slayden.

The lessees are prospecting on a limited scale, doing the work themselves in a winze which is said to be giving good assays from a stringer. An old shaft is reported 175 ft. deep.

Lost Emigrant Mine. This mine, first found in pioneer days and re-discovered in 1895 after a five years' search, is in the high mountains 12 miles by road southwest of Soda Springs station. The first production was made in 1901 and a few thousand dollars was produced annually until 1905; again in 1909 the mine was active, and a tonnage greater than all previously worked was milled, but it proved to be much lower grade than the ore taken out near the surface. No more work was done until 1933. Since then a 10-stamp mill has been erected, but could not be operated because of water shortage in 1934. In the summer of 1934 old mill tailing left from past operations was cyanided. In July, 1935, the sale of the eight claims to Lost Emigrant Gold Mining Company was reported. This is a Delaware corporation. Sanborn H. Smith, agent, 68 Post Street, San Francisco.

The vein which has been worked the most is in diabase porphyrite, and varies in width from 1 ft. at the surface to 4 ft. on the 300-ft. level. It has been prospected to an inclined depth of 500 ft. with short levels at 65, 200, 300 and 500 ft. Some of the oxidized ore from the vein was of very good grade, yielding 2 to 3 oz. gold per ton, but with increased depth the gold recovery dropped and pyrite became more plentiful.

Merz Mine. Six quartz locations in Sec. 4, T. 15 N., R. 13 E., near the head of Antone Canyon. A. Merz, W. Wardell and L. Schnoll. These claims were located in May, 1934. A shaft had been sunk 40 ft. early in August, 1935. There is a new headframe with 40-ton bin and a hoist and small compressor operated by automobile engines, on No. 1 claim. Good assays are reported from the shaft where the hanging wall vein of banded quartz is 8 inches wide, and is separated from footwall vein by 10 ft. of dike rock heavily impregnated with coarse pyrite. The veins strike N. 40° E. and N. 27° E. respectively, in the Blue Canyon formation. No drifting had been done at time of visit.

Mina Rica (Patented in part as *Daylight claim*). This old mine, a mile north of east from Ophir, is on a vein striking northeast in amphibolite schist. Originally, it was 400 by 2700 ft. in area, on a vein one to two ft. wide, traceable for 1000 ft. It was located in 1865 and the surface quartz, and ore taken out 6 to 8 ft. deep, is said to have given ''highly remunerative results''; but no definite record remains of this. In 1873, a shaft that had been sunk 60 ft. was said to have yielded $15,000. Another shaft was sunk, finally reaching a depth of 275 ft. in 1882 and three levels were run, from which a maximum length of 400 ft. was drifted, and an unknown amount of ore was taken. The mine was again productive from 1891 to 1896, with a 10-stamp mill. During these later operations, over $40,000 was produced. No record of the workings from which this ore came was kept in reports made during that period, but later notes indicate a depth of only 150 ft. was reached.

Monarch (*Gratz Brothers*) Mine. In Secs. 14 or 11, T. 13 N., R. 9 E., two miles southwest of Spring Garden, on east side of canyon of North Fork American River. A. D. Hadsell and sons tried out on this property the first Hadsell mill in 1931. It had a wheel 16 ft. in diameter and was operated by a 20 h.p. engine at about twice the speed later used at the Beebe Mine.

The deposit worked is a wide, oxidized body probably similar in character to the Annie Laurie, but too much decomposed at the point where work was going on to permit an accurate classification.

Moore Mine. Near Auburn Ravine, one-fourth mile south of the Conrad Mine. The vein strikes east, crossing the contact of granodiorite and amphibolite. The dip is 55° south and average width 10 inches. The vein was 'pockety.' It was explored by an inclined shaft 480 ft. long sunk in the ore shoot, giving about 200 ft. vertical depth, and drifts were run about 80 ft. east of shaft. It is reported to have been stoped out to an inclined depth of 440 ft. and length of 80 ft. Work continued until 1898. The total yield, according to Ira Tharp, formerly a part owner, was $180,000. The gold was principally free, and much of it carried enough silver to be classed as electrum.

Ophir District.

The quartz veins near Ophir and on Duncan Hill were discovered and worked superficially soon after placer mining started. Under the miners' rules, a quartz claim in Lone Star district could not be over 200 ft. long by 600 ft. wide. The veins that had supplied gold to Auburn Ravine and other streams in the region were worked only in a small way and by 1867 the Julian or Schnabel Mine, with a shaft 105 ft. deep, was the deepest in that section. Many rich strikes had been made at or near the surface. The Green Emigrant, north of Auburn in Rock Creek district had been the most sensational, with a reported yield of $100,000 in 1867.

Mining on a more pretentious scale began about 1871. In that year the *St. Patrick Mining Company* had a shaft 220 ft. deep. There had already been produced from their property $75,000 from a 'pocket.' In 1871, a crushing of 194 tons yielded about $11,000. The Green Mine, one-half mile east of the St. Patrick (and not to be confused with the Green Emigrant) produced the same year, with four stamps in a run of two weeks, nearly $50,000; one lot of 12 tons yielded $15,000. The Bellevue (in late years part of the Oro Fina) in 1872, was said to have yielded in all about 600 tons of an average value of $30 a ton. Crater Mine had a shaft 130 ft. deep on a vein reported to average 12 inches wide yielding $50 a ton. The Julian had four shafts, one 230 ft. deep, with a vein reported 20 inches thick, yielding $6 a ton in free gold. The *St. Patrick Mining and Milling Company* grew into a consolidation covering 14 ledges. For their fiscal year of 1873 this company crushed 3149 tons which yielded about $20 a ton. From the Crater Mine, where they found an ore shoot 203 ft. long at the 212 ft. level, they took that year 1535 tons of ore which yielded $31.52 a ton, the vein averaging 20 inches wide. They also worked the Spanish and Gold Blossom. In all, 18 mines were reported as producing in Ophir district in 1873. Veins varied in average width from 8 to 36 inches. The deepest shaft was 320 ft. A total of 59 stamps, crushing 1½ to 2 tons each daily, were in operation. Wheeler pans were used to regrind concentrate.

In spite of such a favorable beginning, most of these mines did not continue long in operation at the time, though some of them later became producers. The Crater Mine produced $73,951.66 down to the 300-ft. level in the year ended October 30, 1875. Work was resumed on the Gold Blossom in 1881, and in 1883 a 10-stamp mill and a roasting furnace were erected. The same year the shaft of the Crater Mine reached a depth of 800 ft. and a production of $225,000 was reported from it. It was stoped out to the 800-ft. level and work stopped in 1884. If the total production of $750,000 credited to this mine (for half of which no official record is available) is correct, it was the largest producer of the district.

Little more was heard from the district until 1888 when the Butts or Hathaway and the St. Lawrence mines were worked. From 1889 to 1934 inclusive, the mines of the Ophir district made a total recorded production of $1,882,000. The total production of the district, if allowance is made for the many small lots of rich ore mined in early days, of which no definite record remains, must have been close to $3,000,000. Although there has been some production every year since 1889, the amount has fluctuated greatly, the annual output having exceeded $100,000 only in 1889, 1896 to 1898 inclusive, 1902, 1904 and 1916. Since 1921, when the Oro Fina Mine was closed after reaching a depth of 800 ft. with a production of $430,000, there has been no work of importance in the district.

Production of principal mines in Ophir district.

Except where noted, these figures are for period 1888–1934.

Bellevue and Oro Fina	$503,274	(includes $18,000 before 1872)
Crater[1]	383,000	(1873–1910, inclusive)
Gold Blossom	216,741	
Hathaway	336,994	
St. Patrick	148,980	(to and including 1873)
Three Stars	415,000	

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[1] This is the amount for which definite figures are available, and is only one-half the amount locally credited to the mine.

Other mines, for which complete production figures are not available, but which yielded substantial sums, are the Eclipse, Mina Rica, Green, St. Lawrence, Conrad, Centennial, Moore and Julian.

Oro Fina Mine. This mine, the last important producer worked in Ophir district, was a consolidation of claims, some of which had been worked in the earliest days of the camp. It included Bullion, Bullion No. 1 and No. 2, Golden Eagle, Bellevue, Last Chance, Buckeye, California, Smiths Extension and other claims, covering 96 acres in all. Of some of the veins on these claims, it was said in 1871 that they

> "used to be worked by shafts from 30 to 50 ft. deep or until water or hard rock was reached; then the shaft would be abandoned and another sunk. In that way it was prospected or worked for about 1600 ft. * * * to the depth stated; the ore taken out paying from 30 to 100 ounces per ton by arrastre reduction."

Little more was heard of them until about 1899, when the Bellevue became a producer and continued active until 1911. Oro Fina Mining Company took the property in 1913. A new mill was erected and a new shaft was sunk. Work continued until January, 1922. This company produced about $430,000 and the total output of the claims, so far as can be learned, has been over $500,000.

The main vein strikes north of west, and dips 65° south. The Oro Fina Mining Company controlled about 4500 ft. on the strike. The walls were amphibolite schist to a depth between 600 and 700 ft. on the dip, on the west side of the shaft, where granodiorite was found. Work had not gone far enough to prove whether this was the main batholith underlying the amphibolite, or a dike. The new shaft on Bullion No. 1 claim was sunk to a depth of 860 ft. on an angle of 72° in the hanging wall. It connects on the 300-ft. level with the Bellevue shaft, 312 ft. deep. From 200 to 800 ft. inclined depth, levels were 100 ft. apart. Two ore shoots, one on each side of the shaft, were worked. That on the west was about 150 ft. long and the vein was apparently not cut off at the granodiorite contact, where it had a width of 16 inches. On the east the ore was stoped for a length of 250 ft., and raked away from the shaft. The vein occurred as lenticular quartz bodies, seldom over 2 ft. wide, and the walls were hard with little gouge. The average grade of ore in the later operations was nearly $8 a ton (at the old gold price), although specimen ore sometimes was found, one body yielding $90,000. Levels were run as follows:

No. 2—1080 ft. east, 130 ft. west
No. 3—1400 ft. east, 800 ft. west
No. 4—1250 ft. east, 200 ft. west
No. 5— 300 ft. east, 500 ft. west
No. 6— 900 ft. east
No. 7— 100 ft. east at time of last visit, but was run farther before closing.
No. 8— 200 ft. east.

Unlike many mines in the district, the ore here carried most of the gold in the free state. The sulphide, principally pyrite, with some galena, formed 1% to 1¼% of ore and carried $60 to $75 a ton in gold and $4 to $8 a ton in silver. Ore was milled with 10 stamps of 1000 lb. each and two Deister concentrators saved sulphides. The cost of operation ranged from $5.55 to $7.85 a ton.

The present operators have formed the Oro Fina Consolidated Mines. In April, 1936, the shaft had been dewatered and underground prospecting had been started.

Orpheum Mining Company (*Kittler Consolidated*). In Ophir district, adjoining the St. Lawrence on the west. It was worked in early days by a shaft 150 ft. deep and an adit, and a small production was made. In 1909, Orpheum Mining Company began reopening it. A 5-stamp mill was erected that year and later was increased to 10 stamps. The mine was operated several years and produced a few thousand tons of ore which yielded from $6 to $7 a ton, with about 1¾% concentrate which was low in gold content, and relatively high in silver. No details of the underground conditions are to be had as the property has been closed for over 20 years. A depth of 300 ft. or more was reached.

Paragon Prospect. At different times, two quartz veins have been found in the adits run at the Paragon placer mine at Bath, for drift mining. One was struck in the Golden Gate adit about 300 ft. from the portal. Another occurs in the Paragon tunnel 480 ft. from the portal, and work was done on this in 1931 and 1932. When visited in July, 1932, a winze had been sunk upon this vein to a depth of 50 ft. It showed a width of 6 inches to 1 ft. and was claimed to give good assays. It strikes N. 45° W. and dips 48° NE. The adit at this place is only about 6 ft. below the bedrock of the old hydraulic pit.

A small mill containing two stamps, one Wilfley concentrator and a rock-breaker was erected outside the adit and a little ore was crushed, but work stopped in a short time. A small air compressor was in use, and power was furnished by gasoline engines.

Penryn Gold Mines Company. William Anderson, manager, Box 155, Auburn. Home office, 515 Standard Stock Exchange Building, Spokane, Washington.

This company has lately begun sinking a vertical shaft in the footwall of a vein on the Sakui ranch north of the holdings of the Alabama California company. Late in July, 1935, the shaft was 60 ft. deep, with five men employed. It is planned to sink to 200 ft. before drifting. A vein 2½ to 4 ft. wide is reported to have given good assays, with possibilities of a good ore shoot indicated. It is believed to be on the northward extension of the Alabama vein.

Between this and the Alabama mine there is about 1500 ft. in length across the Swesey ranch controlled by the *Alabama California Gold Mines Company* which is reported to have been leased recently to the *Alabama Extension* company.

Early in April, 1936, the shaft of Penryn Gold Mines Company had reached a depth of 200 ft.

Pioneer Mine. This is the deepest and most extensively worked quartz mine in the county. In total gold production, it ranks second in the county. It lies on the steep south slope of the canyon of American River, five miles south of Towle by trail, or it may be reached by road from Forest Hill. It is an old mine, part of it having been worked from 1854 to 1862. It lay idle then until 1880. Some parts of the first mill, built in the 1850's, are still to be seen. In 1889, a 20-

stamp mill was built by James G. Fair and A. E. Davis and active work went on for many years. In 1895 Pioneer Gold Mining Company took the mine over, and reported net operating income until 1900, when the visible ore of good grade appears to have been worked out. Little more was done until 1911, when production was resumed on lower grade rock. In 1922, the last year of mill operation, the yield per ton was the best realized since reopening. For several years, prospecting has been done on a small scale.

The total production of the mine since 1889 has been over $900,000 of which the larger part was produced before 1900. The writer has no record of the yield before 1889. In 1897 and 1898, Pioneer Gold Mining Company gave out reports indicating average yield varying from $9 to $21.77 a ton. The tonnage handled was small, due to a limited water supply for power; in the most favorable season, less than 1000 tons was milled monthly with a crew of 40 to 50 men. This better grade of ore, which permitted payment of some dividends on the $1,000,000 of capital stock came from between the 500- and 1000-ft. levels (the latter being No. 4 adit) where the vein often reached 5½ ft. in thickness.

Of the two developed veins, called the Lynn and the Pioneer, the Lynn has been the principal producer and most of the work has been done upon it. This vein strikes N. 32° W. and dips 70° NE. It follows a strong dike most of the way and is from 1 to 10 ft. wide, but averages 4 ft. or more in most places and is composed of good-looking ribbon rock. It occurs in the Blue Canyon (Carboniferous) formation, having a hard black slate footwall and gray slate and slaty schist hanging wall.

No. 3 crosscut adit cuts the Pioneer vein at a distance of 390 ft. and the Lynn vein at 1400 ft. from the portal, and at a depth of 700 ft., and follows the latter 2525 ft. No. 7, 525 ft. below No. 3, is a crosscut 2800 ft. long to the Lynn vein and is drifted on that vein for 1475 ft. A winze was sunk 242 ft. below No. 7 adit, showing the vein to be 2 to 9½ ft. wide on the bottom level, where it was drifted 225 ft. In all, 13 levels were run. Between No. 3 and No. 4 levels, the vein was stoped nearly continuously for about 1200 ft. The North Lynn stope was 300 ft. high by 700 ft. long, and 1 to 4 ft. in thickness was stoped. The Lynn stope was 325 ft. by 450 ft. by 1 to 6 ft. In later years, stoping extended for a length of about 200 ft. between No. 5 and No. 4. Some stoping was done from the 80-ft. level of the winze workings for a length of 250 ft. to 50 ft. above No. 7, and this is about all the mining done below No. 5 level. There are a number of blocks of the Lynn vein about No. 7 level that offer possibilities, and good prospects are claimed elsewhere on the holdings, which embrace several hundred acres. The Lynn vein has been opened to a depth of 1440 ft. but the Pioneer vein was not prospected below No. 3 level. The company has a complete assay map of workings.

The old 20-stamp mill is about 550 ft. below No. 7 level, and ore was delivered to it by a tramway 1128 ft. long. It has been in bad shape for years. Though it has been stated the sulphides formed 2½% of the ore and were worth $50 a ton, the concentrate treated in later years, in a small cyanide plant, was considerably less in percentage and lower in recovered value than the above. The amount of silver in both bullion and concentrate is low, being less than 1% by value of the gold content.

Providencia Mine (*Providence*). Four quartz claims just south of the old Copper Bottom drift mine, in Iowa Hill district. Providencia claim is patented. The steep slope to North Fork of Shirttail Canyon permitted running an adit, about 400 ft. long, in which some good assays have been obtained in a vein 3 ft. or more in width. No equipment and no recent work reported. The vein strikes northwest and dips 80° NE. in the Carboniferous formation.

Rawhide Mine. On Texas Ridge, between the branches of North Fork of American River, and reached by road and trail from Towle, or by trail from Pioneer Mine. The first available record of activity was for 1899 when a 3-stamp mill was in operation. Rawhide Quartz Mining Company was incorporated in 1901, and a 10-stamp mill was started in December of that year. They had the property until 1909, when it was taken over by *Helester Mining Company.* This company continued operation and made some production nearly every year until 1915 when succeeded by *Canyon Mines Corporation.* Between 1918 and 1934 little was done at the mine but in 1934 production was resumed. The total recorded production has been a little over $300,000, from ore which averaged slightly under $4 a ton in gold (old price) during the principal period of production, 1902–1910 inclusive.

The vein principally worked is a stringer lead in a dike lying between a hanging wall of slate and a footwall of igneous rock, both wall rocks being members of the Blue Canyon (Carboniferous) complex. The width of the lode varies from 4 ft. to 140 ft.

The steep surface permitted exploitation by adits, of which four have been run as follows:

No. 1 (upper)	1137 ft. long,	giving 400 ft. depth
No. 2	1862 ft. long,	giving 510 ft. depth
No. 3	2350 ft. long,	giving 696 ft. depth
Mill adit	840 ft. long	

A ball mill of 35 tons capacity is reported to have been used for milling during the past year. Thirty men were employed in May, 1935. The ore milled in 1934 yielded less than 1% concentrate, which, however, was of good grade, containing about 40% of the gold saved.

Redstone (*Red Rock*) *Mine* is two miles southeast of Blue Canyon near North Fork of North Fork of American River. It was first worked in the 1860's, when a 4-stamp mill was in operation, and production was made from an open cut. In 1896 a 10-stamp mill was built, and a few thousand dollars was produced annually until 1902. The ore at that time came from stopes above adits, of which three were run, giving a depth of 250 ft. The tonnage mined was small, however, during this latter period, and the ore was low grade, the adit workings, width of vein and free water power for milling permitting a profit.

Nothing more appears to have been done until 1932 when *Paramount Gold Mines Corporation, Limited,* began a new lower adit to give greatly increased backs below the old workings. The activities of this company ceased with the death of the promoter, E. C. Klinker. There is an old 10-stamp mill above the new adit level.

The Redstone deposit occurs in the Blue Canyon formation and consists of a massive vein of quartz, and a stringer lead of quartz seams in slate, forming a low-grade lode up to 15 ft. wide. It strikes nearly north and dips 60° W.

Rip Van Winkle (Page & Buckman or *Lady Bedford) Mine.* J. D. Dodds, 1614 26th Street, Sacramento, and heirs of Ben Buckman, owners. It is six miles south of Westville in Sec. 29, T. 15 N., R. 12 E.

The vein was worked first through shallow shafts and an upper adit at an elevation of 3520 ft. A lower adit was then run S 80° 50′ W. 237 ft. to vein and 89 ft. beyond it, and a drift run 532 ft. in a general northerly direction, at an elevation of 3250 ft. No ore was mined from the lower adit. Nothing has been done at the claim for about 20 years and at present the portal of the lower adit is caved.

Two small stamps were operated on ore from the upper workings from 1894 to 1897 inclusive, and a total of a few thousand dollars was produced.

The *Schultz Mine*, presumed to be upon the northward extension of the same vein but separated from the Page & Buckman mine by 1000 ft. belonging to the Herman Mine, also had a 2-stamp mill in 1897.

Rising Sun Mine is a mile and a half west of Colfax. It was opened in 1866 and was operated eight years with a 5-stamp mill, and from then until about 1884 with 10 stamps. The latter mill had a daily capacity of only 20 tons. In spite of this limited capacity, the mine was reported to have yielded over $2,000,000 which, if correct, would make it the leading gold-quartz producer of the county. In 1869, when it was 230 ft. deep, the average yield was given as $25 a ton. In 1875 when a depth of 520 ft. had been reached, the average width of ore was 15 inches and average yield $21.50 a ton. The total production to July 1, 1875, was about $405,000. Unfortunately, no public record remains of operations from then until the closing about 1884. The mine lay idle thereafter until 1919, when a stock company erected a modern 10-stamp mill and unwatered the mine. They reported milling less than 1000 tons before quitting. Again in 1925, the same promoter, with a company called *California Premier Mines Company* reported milling about 1000 tons of good ore. Considerable dead work was done to complete a drain adit from the Bear River slope connecting with the workings about 30 ft. above the 600-ft. level, and the plant was improved. The same interests did some work on the adjacent Big Oak Tree Mine, and in 1931 were succeeded by *Paramount Gold Mines Corporation.* This company made some production in 1931 and 1932, working in both mines, and some of this output in the latter year was credited to the Rising Sun.

The vein is said to have averaged 18 inches wide in the upper levels and lies between hard diabase walls. It strikes northeast and dips 85° south to the 7th level where it reverses its dip. Below this 'roll,' the vein widened to 4 ft. or more, and became softer. The oldest shaft, from which the early production came, was sunk to the fifth level, and another to the third level. A later and deeper one was sunk northeast of these, to 749 ft. on the dip of vein. West of it, according to the late James Richards, a former superintendent, was a pay chimney about 40 ft. long, so rich in free gold near a cross-fault that "the gold literally held the quartz together." This fault apparently bounded the rich ore on this side, and possibly had influenced its deposition. East of this shaft, pay was in stringers. On the west, it paid well to a depth of 700 ft. where the 'roll' in the vein occurred.

Of the last ore milled, and credited to this mine, sulphides formed about 1.7%, and yielded 2 oz. gold per ton. The promoter, however, was interested in several mines in different parts of the county, from which lots of ore may have been milled in this plant; so individual figures can not be safely given.

Rublin Mine is about one mile southwest of Last Chance. About 1908 to 1911, a shaft was sunk 150 ft. and an adit run about 860 ft. Less than 1000 tons of ore mined from the shaft workings was reported as yielding from $4 to $11 a ton in a 2-stamp mill. The adit is said to have not struck the vein, but a winze sunk 30 ft. below the adit is claimed to give good prospects. Some low-grade material was milled in 1929 and 1930. Recently work was resumed and in August, 1935, five men were employed. It was not visited by the writer, but the vein is reported to be from 6 inches to 2 ft. wide.

Shady Run (*Midas*) *Mine*. It is about a mile and a half northeast of Shady Run. Work began in 1900 and a 10-stamp mill was put in operation in 1902. In three years, about 6000 tons of low-grade ore was milled, after which little appears to have been done, although Shady Run Mining Company is still in existence and gave a lease in 1927 to Thomas W. Wells. In 1934, a few ounces of gold was produced from low-grade rock. Mining was done through adits and a shallow shaft. The vein is reported to show a width of 20 ft. or more and consists of a quartz stringer lead in a dike, carrying considerable sulphide including some arsenopyrite.

Snowbird Mine is one mile from Sugar Pine Mill, on the divide 14½ miles east of Forest Hill. Two veins are claimed to exist, but these show little quartz, and what ore has been found is mostly in talc zones in serpentine, which strike northwest and dip 60° N. E. *Nevada-Pacific Exploration Company* prospected the ground for two years, 1919–1921. A shaft was sunk nearly 300 ft. on 60° incline, with levels at 56, 134 and 285 ft. depths. Short drifts were run on each level, the most extended being on the 134-ft. level where the 'footwall vein' was prospected for 150 ft., a crosscut was run 140 ft. and the 'hanging wall vein' was followed 190 ft. by drifting. A little rock was stoped between this level and the next above. The mill in 1921 contained five light stamps, a 50-ton ball mill and a small cyanide plant, all removed since.

Southern Cross Mine comprises four patented claims, covering 2560 ft. in length along the strike of veins on the south side of the canyon of South Fork of North Fork of American River, five miles south of east from Towle, and adjoining the Pioneer Mine on the northwest. From Towle it may be reached by road and steep trail. The principal period of work was between 1903 and 1908, during which time the production of about 4800 tons of low-grade ore was reported. The recorded figures are only approximate, but indicate a yield of $3 to $5 a ton. Fred M. Miller, who has made an excellent report on the property, estimates a much higher probable yield. The plant was burned down some years ago, and later part of the 20 stamps were removed.

Three veins called West, Southern Cross or middle, and Poole or east vein occur, striking west of north in the Blue Canyon formation. Most of the work has been done on the Southern Cross vein, through No. 1 tunnel, which starts about 50 ft. above the south bank of the river, runs as a crosscut south and then east 540 ft. to the vein, and follows the vein as a drift 180 ft. south, and 320 ft. north. The north drift emerges near the river at the east portal, which is 400 ft. upstream from the main entry. From this level two small stopes were mined. This vein has two strands and the stopes are on the hanging wall section. Frenzel stope is nearest the portal and is 70 by 100 ft. in area and 5 to 6 ft. wide, reaching to the surface. The other stope is about 50 by 50 ft. in area. On the footwall side is a stockwork of quartz stringers which is 42 ft. wide where crosscut by the main adit.

No. 2 adit level is 215 ft. above No. 1 and has a total of 200 ft. of work, of which 120 ft. is on the hanging wall strand of vein, with a raise through to No. 3 adit level, 75 ft. higher. Small stopes were mined above the latter, on both strands of the vein. About 2500 tons in all was mined here, some of it reputedly above the average grade for the mine.

On the Poole vein, which Miller thinks is the northward extension of the Lynn vein of the Pioneer Mine, a length of 30 to 40 ft. was stoped from the Upper Water adit, 387 ft. vertically above No. 1. This adit was scarcely 100 ft. long and the stope went to the surface. Another adit 45 ft. lower and the same length, did not reach the ore shoot indicated by the stope above. The outcrop of this vein is said to be traceable thence for 2100 ft. to the Pioneer end-line, where its probable connection with the Lynn vein is claimed to be indicated. In both properties, the vein is accompanied by a dike.

The Southern Cross development work, consisting of a total of about 2500 ft., has been done almost entirely on the Southern Cross and Poole claims. Due to their location, they offer exceptional opportunities for prospecting by adits. No. 1 level of the Southern Cross is 1100 ft. vertically below No. 7 level of the Pioneer, and 858 ft. below the deepest development in that mine. It would have to be extended about 2000 ft. southward to enter Pioneer ground, which extends more than a mile farther south on the strike.

St. Lawrence Mine. In Ophir district, one-half mile northwest of the old town. It had a 6-stamp mill in 1873, and was worked irregularly for 25 years or more. Some ore was shipped to a smelter, some treated in a nearby mill and in the 1890's a Huntington mill was installed. The complete record of output is not available, but for a few years, 1893 to 1897, a total of $21,370 was reported. Between 1903 and 1912, there was also some production from this claim.

The work was done principally on the eastern part of the claim, where the vein strikes east and dips 20° to 45° south. The vein is from 1 ft. to 20 inches wide of glassy quartz carrying up to 2% of pyrite and galena, with some stibnite. Two ore shoots were claimed, 180 ft. and 100 ft. long. The bullion was only 650 to 700 fine. Both walls are granodiorite with a diorite dike on the hanging wall of vein. Much, if not all, of the ore is said to have come from a stringer in the hanging wall parallel to the main vein. Farther west, the vein or one which joins it, strikes nearly due southwest.

The shaft, 300 ft. long, was intersected by two tunnels, the upper reported 650 ft. long and the lower 350 ft. long in 1896, the latter connecting with the bottom of shaft and giving a vertical depth of about 150 ft. In the later work the adits were extended.

St. Patrick Mine (Doig Consolidated). What was later known as the Doig Consolidated Mine was originally called the St. Patrick and was quite actively worked in the 1870's by St. Patrick Mining Company, which operated as well at other nearby properties. The St. Patrick shaft is in the SW¼ of SE¼ Sec. 7, T. 12 N., R. 8 E., on the southern contact of a tongue of amphibolite about 500 ft. wide and one-half mile long, which lies like a peninsula in the granodiorite. The St. Patrick vein is at the southern tip of the peninsula, and is one of several which strike northeast across it.

This vein is said to have yielded near the surface a 'pocket' of $75,000. In March, 1871, between $11,000 and $12,000 was produced from a small tonnage of ore, and for the year ended October 30, 1873, the company mined and milled from the St. Patrick vein 3149 tons which yielded $16 to $20 a ton. In that year, J. H. Crossman, the superintendent, reported his conclusion that the main shaft had passed through the ore shoot at the 200-ft. level, and that the shoot raked east at such a flat angle that a drift 800 ft. long would be required to reach it at the 300-ft. level. Accordingly, he quit work on that vein and later activities of the company were on other mines, including the Crater and Spanish. Crossman reported the shaft as being 320 ft. deep, with 425 ft. of drifting on a vein averaging 20 inches thick. It dips about 45° E.

The Doig vein is the next east of the St. Patrick, and only 120 ft. from it, but to the south it curves until its outcrop strikes nearly west in the granodiorite. Although this vein has been traced about half a mile, the only payable ore found so far in it was a few hundred feet northeast of the St. Patrick shaft, where, at its junction with a narrow, nearly vertical vein called the Little Doig, a good-sized 'pocket' was extracted. In this place, the vein is in the amphibolite schist.

Tahoe Treasure Prospect. In 1932, publicity was given a discovery of auriferous sulphides made near Quail Lake in the high Sierra Nevada, about one mile south of west of McKinneys, a resort on Lake Tahoe. A number of locations were made, some of which were later found to be on land claimed by others under patents issued years before. The elevation is from 6750 to over 7000 ft.

Fresh sulphides occur almost at the surface in several places on the claims, in contact-metamorphic rocks, originally principally sedimentary and believed to be of the same age as the Sailor Canyon formation (Juratrias?). The strike of schistosity in the altered sediments (quartzite and slaty schists) is in general N. 20° W. These rocks form a small roof-pendant, flanked on the south and east by morainal deposits and on the north and west by andesite and granodiorite. The bands of sulphide mineralization, in places at least, appear to follow the direction of the schistosity. The cliff on the south side of Quail Lake is heavily iron-stained, and the first prospect hole here showed plentiful fresh iron sulphide with traces of copper. A short adit just south of the lake at that time showed about one-half the face occupied by granite. A 50-lb. sample here was said to show 7 lb. of concentrate assaying well, though the sulphide did not appear as plentiful here as above.

Since 1932 a total of over 400 ft. of underground work has been done. Several stock companies have been based on the prospects, and it is said that about $100,000 has been spent in connection with them. An electric power-line was built from the state highway to the claims, a 10-room dwelling, and expensive assay office and other buildings were erected, and an air compressor, drill sharpener, etc., installed. It is said a dog-team was used in the winter of 1934–35 to haul in steel and provisions.

Assays indicate widely varying gold content, from a trace to over one ounce. Cyanide and gravity concentration tests are reported to give unsatisfactory recoveries. The last company reported in control is Tahoe Treasure Consolidated Mines, Incorporated, which continued work during 1935.

Three Queens (*Four Aces*) *Mine* is part of a group of claims extending for 2 miles along a dike of serpentine and its contacts with schists, in Volcano Canyon 1 mile north of Middle Fork American River. A road 3 miles long from Forest Hill drops 1800 ft. in reaching the camp, which is at an elevation of 1360 ft.

The first reported production was of $14,000 in early days; the first recorded was made by George Wingfield in 1907 and amounted to over $30,000. This was taken from a small 'pocket' orebody only a few feet underground. In 1909 and 1919 Mortimer Savage, the owner, reported production of a few thousand dollars. Some gold was also taken out in 1925 by Three Queens Mining Company. *Four Aces Mining Company* was in control of the mine from 1926 to 1928, inclusive, and reported output of over $80,000. M. Savage resumed work in 1930 and the mine has been producing gold annually since.

The area mapped as peridotite and serpentine contains strips of black graphitic schists, which were torn from the older Carboniferous rocks by the invading intrusive, as well as completely altered rocks probably once dikes. The serpentine also carries talc and ankerite stained by mariposite in places. To the west lies amphibolite schist.

The work done up to July, 1927, showed a quartz vein 3 to 4 ft. wide, striking northwest and dipping 30° to 40° NE. It had there a hanging wall of black graphitic schist and altered dike, with ankerite stained by mariposite on the footwall in those sections where the best ore was reported. Three stopes, the longest 90 ft., had been opened. High-grade ore occurs in small bunches showing considerable free gold in this vein. It evidently formed along the hanging wall by repeated opening and the graphite, and the carbonates in the ankerite, were favorable precipitants. Near the southeast end of the adit drift, 348 ft. from the portal (which is near the trough of Volcano Canyon) a floor dips N. 20° W. Gold occurs in the filling of this flat seam. Such seams are probably due to hillside drag. About 1000 ft. southeast from the face of this drift there is a winze 148 ft. deep on the Scorpion claim. To the northwest, 1250 ft. away, 120 ft. of workings along the contact are reported to show good assays. A 5-stamp mill, 40 h.p. semi-Diesel engine, air compressor and several good buildings are on the claims.

In October, 1935, Mrs. Rena Morgan et al. were working the property and another strike of specimen ore was reported from the same ore shoot previously worked by Wingfield and the *Four Aces Company,* at a depth of about 265 ft.

Three Stars (*Columbia*) *Mine.* The three claims, called North Star, Middle Star and Morning Star, lie at the northwest end of the Ophir district, on Doty Ravine, seven miles northwest of Auburn. Although considerable work had been done before 1900 on these claims, no history of it remains. By that time, three shafts had reached the following depths: Main vertical shaft, 725 ft., Belmont vertical shaft 524 ft. and Belmont incline, 500 ft. The principal period of activity was from 1902 to 1907 inclusive, during which time over $400,000 output was reported. Most of the deeper work is reported to have been done in a winze sunk from the 700-ft. level to 1300 ft. depth. The owner has a map showing the extent of workings. The ore was of low grade, yielding $3 to $6 a ton. Sulphide concentrate saved formed 1% to 1½% of ore and carried $40 to $50 a ton in gold and $2 to $10 silver. Tailing assays were low. Milling was done with 20 stamps.

This mine is in the granodiorite and the veins strike north. Not much work was done on the Almont vein, from which a few thousand dollars was produced in 1889. The main vein is said to have been about 3 ft. thick in the ore shoot.

T. W. A. (*Big Pine Mine*). In Ophir district, about one-half mile from Wise power-house. A. N. Sweet, trustee. C. H. Brown, superintendent, Auburn.

The date of the first work on this ground is not known. It was reopened, however, in 1898 by Bouk & Bushnell and worked in a small way until about 1907 with the production of a few thousand dollars from ore which yielded from $3.50 to $10 a ton in gold. Copper sulphide was reported at a depth of 170 ft. It lay idle thereafter until 1934, when it was reopened and sampled. Early in 1935, a plant containing a balanced rod mill, concentrator and three flotation cells was installed and milling started. There are levels 100 ft. apart, the longest drift being 250 ft. east and 240 ft. west on the 300-ft. level. A. N. Sweet reported average assays of about $10 a ton from a vein averaging 18 inches wide. The mill was crushing 35 tons a day in June, but work was reported to have been suspended late in July.

Two Orphans Prospect adjoins the Green Emigrant mine on the north, five miles from Auburn in NW¼ Sec. 30, T. 13 N., R. 8 E. It was worked superficially by Pike Bell as a pocket mine about 1865. Two veins strike northwest and dip 54° east, having a maximum width at and near the surface of 2 ft., and averaging 14 to 18 inches. Shallow shafts were sunk at close intervals for 1500 ft. on the strike. The deepest shaft prior to 1920 was only 75 ft. deep on the dip. A shallower shaft on the other vein is said to have shown it breaking into stringers and lenses of quartz assaying well. The ore on this claim shows considerable pyrite, chalcopyrite and galena. The walls are hard greenstone.

Valley View (*Harpending* or *Whiskey Hill*) *Mine*, six miles north of Lincoln in the foothills just east of Sacramento Valley, is one of the old copper mines of the foothill belt which had an interesting early history as a gold producer from gossan ore, similar to that recently worked at the Dairy Farm mine.

Whiskey Hill had a 40-stamp mill crushing the gossan ore in the 1860's. The deposit had been studied by Professor Silliman, who reported the presence of gold in angular grains or small ragged pieces; films of metallic silver upon the ''talcose masses,'' and the occurrence of such minerals as coquimbite and cyanosite.

The mineralized zone has a width of 200 ft. between amphibolite schist walls, striking N. 80° W. and dipping 72° northeast. In this zone the gossan was about 100 ft. wide. The deposit from which the gossan came and which carries copper and zinc ores in depth, is in two altered dikes, probably originally andesite. The oxidation of the rock carrying sulphides, and the action of the acid-bearing water left a skeleton of residual quartz and kaolin in places as well as the usual gossan. Copper sulphides and pyrite were found at a depth of 85 to 100 ft. In the lower workings, zinc sulphide and pyrite increased and copper content became less.

There are three shafts and several open cuts and adits on the mine. South shaft is 130 ft. deep, southeast shaft 180 ft. and northwest shaft 280 ft. deep. From the last, ore was stoped from 120-ft. level to the surface. In southeast shaft, at a depth of 150 ft., a drift was run 125 ft. During the last period of operation, in 1916 and 1917, a few hundred tons of ore was shipped yearly, which yielded from $3.50 to $5 gold, $1.50 to $2 a ton in silver, and 3½% to 5% copper. There still remains a small tonnage of the gossan ore.

For many years the water flowing from an old adit connecting with a winze has been used locally, and has been bottled and sold under the name of Kilaga Water, for the treatment of certain skin diseases and poison oak. An analysis of this water was published in our Report XVIII, page 603.

Van Avery Mine (*Alder Creek Gold Mining Company*). It is 1½ miles southeast of Blue Canyon. It was first mentioned as having a 3-stamp mill in 1896. In 1897, Alder Creek Gold Mining Company took it over and worked about 3 years, having 28 men employed in 1899. Two adits were each run 300 ft. or more according to report. Three veins are claimed, one of which is 5 to 6 ft. wide. No record of the production is available, and no work has been done in late years.

Victory (*Russell & Phelps*) *Mine* is in the SE¼ of SE¼ Sec. 13, T. 15 N., R. 9 E., five miles northeast of Colfax by road. Agricultural patent.

Some prospecting was done 35 years ago on this land and in 1901 about 7½ tons of ore was shipped which yielded an average of over 2 oz. gold and 1 oz. silver per ton. Work stopped at a depth of 81 ft. and nothing more was done until Russell and Phelps discovered an outcrop of heavy gossan ore near the old workings in 1931. This showed no visible free gold, but assayed well, and 21 tons taken out in sinking 58 ft. yielded 2.2 oz. gold and 12.2 oz. silver per ton at Selby smelter. Another lot of 23 tons yielded over 1½ oz. gold and 9 oz. silver per ton.

At a depth of 88 ft. the assay returns indicated enough decrease in gold content to discourage the lessees and work was suspended until 1934 when Loufek, Johnson and Springer reported production of over 1000 tons of ore.

The ore occurs in lenses of heavy sulphide (principally pyrite) in the Carboniferous rocks (locally called Cape Horn slates) where narrow bands of igneous rock, now rendered schistose, are interlayered with the slate. The strike is nearly north and dip 72° E. The upper 35 ft. of the discovery vein is 3 ft. in the footwall from the lower segment. At 55 ft. a crosscut 16 ft. in the footwall revealed another vein of the same kind and about 3 ft. wide. A fault striking N. 40° W. and dipping 45° SW. cut this vein off above this level, and if this is the same fault that moved the first vein, the upper segment would lie west also.

The later work (1934) has been done in a winze sunk in the floor of an old adit run in 1901 about 250 ft. east from a nearby ravine toward this latter (west) vein from which the first shipments came.

Vore (Golden Scepter, Chubb) Mine. In Sec. 3, T. 13 N., R. 9 E., two miles east of Applegate on Codfish Canyon, and about one mile south of the Black Oak Mine. This is one of the seam mines, which was hydraulicked years ago and later worked in a small way. Recently prospected, and a 5-stamp mill was operated for a short time by Navone.

The deposit is at the contact of Carboniferous rocks with a small outcrop of serpentine.

At present (July, 1935) litigation has been started between the lessee and owner.

Wubbena Mine. This is 10 miles in an air-line south of Soda Springs station, and not far from the Lost Emigrant mine. Due to the rugged topography, lack of a road and the occurrence of sulphide ore, little has been done in years past. In 1934, a small tonnage of good ore was mined and packed out over a trail to Robertson Flat on the road for shipment to the smelter. The expense of handling it was said to have used up most of the proceeds.

TABLE OF QUARTZ MINES AND PROSPECTS, PLACER COUNTY

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Adams	20	12 N.	8 E.	Calvin T. Adams, Newcastle		R. XIII, p. 272; XV, p. 331
Alabama	35	12 N.	7 E.	Jane C. Williamson and Elizabeth C. Small. Loomis. Operating company: Alabama-California Mng. Co., Wm. Anderson, Gen. Mgr., Auburn		R. XXXI, p. 17
Alameda	25	14 N.	9 E.	J. F. Wise and Martin Partridge, Colfax		R. XV, pp. 331-332
American Bar	33, 4, 5	14 N.	11 E.	American Bar Quartz Mining Co., W. H. Duffy, Pres., E. Holland, Sec., 859 Mills Bldg., San Francisco		R. XII, p. 204; XIII, p. 273; XV, p. 332; XVIII, pp. 261-262; XIX, p. 141; XX, pp. 13, 81-82, 179; Pre. Rep. 8, p. 31; XXIII, pp. 248-49; XXXI, p. 17
American Eagle						See Suckers Revenge
American Monarch						See Suckers Revenge
Anchor Mng. Co.						See Dorer
Andy Ferrier Diggins						See Langstaff & Storey
Annie Laurie	24, 25	14 N.	9 E.	R. H. Young, Weimar, et al.		R. XV, p. 332
Auburn	16	15 N.	12 E.	Emma J. Prewett, % W. J. Prewett, Auburn; Wm. I. May, Colfax, et al		
Auburn-Chicago						See Chicago
Australian	25	15 N.	10 E.	Australian Quartz Mining Co., % Eleanor Meek, 1202 Arguello Blvd., San Francisco	95	
Bazacoo	22, 23, 26	13 N.	9 E.	James Sheridan, Auburn		R. XV, p. 332
Beauty	9	15 N.	13 E.	Henry Snyder, Grass Valley	40	R. XV, p. 332; XXIII, p. 249; XXXI, p. 17
Belle Union	35	14 N.	9 E.	D. Jones, Clipper Gap		R. XIII, p. 273; XV, p. 332
Bellevue	7, 8	12 N.	8 E.			R. XIII, p. 274; See Oro Fina
Belvoir	18	12 N.	8 E.	J. Kaiser, Ophir		R. XV, p. 332
Big Ben Cons.	25	13 N.	6 E.	Big Ben Con. Mining Co., Box 55, Lincoln	67	R. XXIII, p. 249
Big Blue	3	15 N.	10 E.	Moody & Garety, Gold Run		R. XIII, p. 274; XV, p. 332
Big John	25	14 N.	9 E.	Ed. Bigley, E. B. Odell, M. L. Odell, E. H. and M. A. Hinchey, Weimar		R. XV, pp. 332-333
Big Oak Tree	33	15 N.	9 E.	Wallace Werry, 2215 H St., Sacramento, and D. A. Russell, Colfax	10	R. VIII, p. 463; XIII, p. 274; XV, p. 333; XX, p. 179
Big Tree	16	15 N.	12 E.	William I. May, Colfax, et al.		
Bisbee	19	13 N.	10 E.	George H. Bisbee, McKeon	167	
Bishop						R. XIII, p. 274
Black Canyon	2, 3, 8, 10	15 N.	12 E.	Black Canyon Mining Co. of California, % E. B. Quigley, Auburn	640	R. XIII, p. 274; XV, p. 333
Black Hawk	4	15 N.	11 E.	Black Hawk Quartz Mining Co., 347 Clinton Ave., Roseville		R. XXIII, p. 249
Black Oak	35	14 N.	9 E.	Elsie A. Drexler, 1037 Mills Bldg., San Francisco, et al.	20	R. XII, pp. 274-275; XV, p. 334

Black Spanish No. 2	7	12 N.	8 E.	J. E. Walsh, East Auburn		R. XV, p. 334
Blue Bell	3	15 N.	11 E.	A. Percival Crittenden, Towle		R. XV, p. 334
Blue Jay	31, 32	14 N.	11 E.	Lorenzo de Maria, Butcher Ranch		
Blue Wing	28	15 N.	10 E.	W. A. Hilliard, Grass Valley	40	R. IX, p. 29; XV, p. 334
Bobtail	18	13 N.	7 E.	Wm. Recknagel, Auburn		R. XV, p. 334
Bonanza	11	15 N.	11 E.	Jerry J. Sullivan, San Francisco		R. XV, pp. 334-335
Bonnie Bee	3	16 N.	11 E.	Bonnie Bee Quartz Mining Co., % L. W. Cummings, 683 Haddon Road, Oakland	198	R. XV, p. 335
Bonnie Bell	18	16 N.	11 E.	Bonnie Bell Quartz Mining and Development Co., Dutch Flat		
Booth	8, 9, 16	12 N.	8 E.	Slosson & Spinney Estates, % E. P. Slosson, Auburn	10	R. XVII, pp. 442-443
Boulder	18	12 N.	8 E.	Jack Smith, Ophir		R. XII, pp. 205-206; XIII, p. 275; XV, p. 335
Boulder						See Julian Mine
Bree	2, 3	15 N.	11 E.	Wm. M. Bree		R. XVIII, p. 301
Buena Vista	24	14 N.	9 E.	Ed. Bigley, Colfax		R. X, p. 426; XV, p. 335
Bullion	7, 8	12 N.	8 E.			R. XIII, p. 275
Bunker & Nihill	32	14 N.	11 E.	H. H. Bunker and J. A. Nihill, Michigan Bluff		R. XV, p. 335
Burner	14	13 N.	9 E.	J. W. Burner, Forest Hill		R. XV, p. 335
Burt						See Dewey & Stocker
Butts	21	12 N.	8 E.			R. VIII, p. 461; XIII, p. 276; XV, p. 335; See also Hathway
Calf Pasture	34	13 N.	8 E.	W. E. Dean, Kohl Bldg., San Francisco		R. XIII, p. 276; XV, p. 335
California	16	12 N.	8 E.	Mr. Hubbell, Auburn		R. XIII, p. 276; XV, pp. 335-336
Canada Hill						See Beauty
Carter, Wallace & Augustine	33, 28	15 N.	13 E.	F. G. Albonos, Michigan Bluff; A. C. Lowell, San Francisco	62	Field Report
Cash in Dump				H. M. Black & H. J. Ellert, Virginia City, Utah		R. XV, p. 336
Centennial	17	12 N.	8 E.	Anna M. Walsh, Auburn	10	R. XV, p. 336; XVII, p. 443; XVIII, pp. 263, 301-302; XXIII, p. 249
Central	3	15 N.	11 E.	Central Mining Co., H. T. Power, Pres., Berkeley	21	R. XV, p. 336
Central Cons. Humbug	7	12 N.	8 E.	Jose G. Silva, Newcastle, et al.	19	
Champion	15	14 N.	11 E.	R. H. Summers, Michigan Bluff, et al.		R. XII, p. 206; XIII, p. 276; XV, p. 336
Cherokee						R. XII, p. 206; XIII, p. 276; XV, p. 335
Chicago	32	16 N.	14 E.	Tom Young, Cisco		R. XV, p. 336
Chicago	35, 36	12 N.	7E.	H. R. Owen, Penryn. Lessee, Auburn Chicago Mng. Co., Penryn		R. XXIII, p. 250; XXXI, pp. 17-18
Christmas Hill	26	13 N.	9 E.	J. A. Ware, Butcher Ranch		R. XV, p. 337
Colorado & Trio	7 12	12 N. 12 N.	8 E. 7 E.	Caroline Reed, R.F.D. 1, Box 27, Sacramento	28	
Columbia						See Three Stars
Conrad	17	12 N.	8 E.	Anna M. Walsh, Auburn	10	R. XV, p. 337; XVII, p. 443; XVIII, p. 320
Continental	26, 35	13 N.	9 E.	Wm. Spargo, Georgetown	9	
Crandall	8	12 N.	8 E.	T. F. Jull, Auburn	37	R. XV, p. 337; XVII, pp. 443-444
Crater Hills Cons.	12 7	12 N. 12 N.	7 E. 8 E.	Harry Ardene Williamson, Lincoln	24	R. X, p. 433; XII, p. 207; XIII, p. 277; XV, p. 337
Crosby	25	13 N.	6 E.	F. C. Crosby, Lincoln	17	
Cuckoo	16, 4, 9, 10	14 N.	12 E.	% F. N. Tillotson, Michigan Bluff		

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TABLE OF QUARTZ MINES AND PROSPECTS, PLACER COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Dahlonega	12 7	16 N. 16 N.	11 E. 12 E.	Donald J. Bell, 157 Ronado Ave., Piedmont	41	R. XIII, p. 277; XV, p. 337
Dairy Farm	27	14 N.	6 E.	Lease and option: Dairy Farm Gold Corp., Box 326, Lincoln	160	Bull. 50, pp. 208-209; XV, pp. 327-28; XVIII, p. 45; XXIII, p. 246; XXXI, p. 18
Daniel Webster	22	14 N.	11 E.	R. H. Summers, Michigan Bluff, et al.		R. XII, p. 207; XIII, p. 277; XV, p. 337; XX, p. 13
Debb	4	15 N.	11 E.	A. Percival Crittenden. Towle		R. XV, p. 338
De Maria	6, 7	13 N.	10 E.	C. J. de Maria, McKeon	214	R. XV, p. 338; Pre. Rep. 8, p. 32
Dewey	22	13 N.	9 E.		35	R. XV, p. 338
Dewey & Stocker	30 25	14 N. 14 N.	11 E. 10 E.	Sadie B. Hewell, Auburn & Mrs. Elsie S. Jensen, Paradise	44	R. XIII, p. 277; XV, p. 338
Doig	7, 18	12 N.	8 E.	Estate of W. S. Kendall, Box 257, Sacramento	13	
Dolores & Black Spanish	7	12 N.	8 E.	Walsh Estate, % J. E. Walsh	6	
Don Prospect				John Lass & Walter J. Wren, Virginia City, Utah		R. XV, p. 338
Dorer	3	15 N.	11 E.	L. R. Dorer, Auburn. Lease and option: American River Gold Mng. Co., 111 Sutter St., San Francisco		R. VIII, p. 468; XII, pp. 207-208; XIII, p. 277; XV, p. 338
Drummond	1	14 N.	10 E.	Estate of C. F. Reed & J. E. Walsh. Freeman Hotel, Auburn		R. X, p. 424; XII, p. 208; XIII, p. 277; XV, p. 338; Pre. Rep. 8, pp. 31-32
Dry Hill & Blue Jay	31, 32	14 N.	11 E.	Clementina deMaria, McKeon		R. XV, p. 338
Eagle	2, 3	15 N.	11 E.	Wm. M. Bree and Eagle Gold Mng. & Milling Co., 427 Western Mutual Life Bldg., Los Angeles		R. XVIII, p. 301
Eclipse	17	12 N.	8 E.	Estate of F. D. Hussey, % Fidelity Trust Co., 210 5th St., Louisville, Ky.		R. X, p. 433; XIII, p. 277; XV, p. 338; Bull. 50, p. 207
Elizabeth				John Watson, Penryn		R. XVII, p. 445
Ellen Dip						See Gold Scepter
Eureka	13	12 N.	7 E.		69	R. XV, p. 339
Eureka Cons.	1 31	13 N. 14 N.	9 E. 10 E.	O. F., Wm. and G. Seavey, W. A. Shepherd, H. Adams & G. Coffin, Foresthill		R. XV, p. 339
Eva Lode	36	14 N.	10 E.	Alice S. Garrison, 1400 N St., Apt. 2, Sacramento	7	
Evening Star	27	15 N.	9 E.	S. K. & Minnie G. Williams, Colfax		
Falls Creek						See Chicago
Fall Ravine	14	15 N.	13 E.	M. Savage, Foresthill		R. XII, p. 208; XV, p. 339
Flat Ravine	27	15 N.	13 E.	Flat Ravine Quartz Mine, 242 Polk St., San Francisco		R. XII, p. 208; XIII, p. 278
Four Aces						See Three Queens
Galma, Patrick & Patrick Ext., Tunnel Mine				Black Canyon Quartz Mng. Co., % E. B. Quigley, Auburn		See Black Canyon
Garbe						See de Maria
Gem	2, 3	15 N.	11 E.	Sam J. & Eva Rablin, et al., 1636 3d Ave., Oakland		R. XV, p. 339

Gold Blossom	12	12 N.	7 E.	Mutual Security Co., % J. E. McDonald, & McDonald, Oakland		R. X, pp. 431, 433; XII, p. 209; XIII, pp. 278-79; XV, pp. 339-40; U.S.G.S. XIV R., Pt. 2, p. 270
Gold Dike				H. H. Marsh, 415 Mill St., Grass Valley		R. XXXI, p. 18
Golden Eagle				Mrs. Thos. Bailey, Box 245, Nevada City, et al.		R. VIII, p. 464
Golden Reward	5	15 N.	13 E.		20	R. XV, p. 340
Golden Rule	17	11 N.	8 E.	Wm. Kendall, Sacramento		R. XV, p. 340
Golden Scepter	3	13 N.	8 E.	Ed. Vore, Applegate & E. Ephraim		R. XIII, p. 279; XV, p. 340
Golden Sheaf	27	14 N.	11 E.	Golden Sheaf Mng. Co., E. P. Thompson, Mgr., Michigan Bluff		R. XV, p. 340
Golden West	34, 35	16 N.	11 E.	Aphra West, % Chas. W. Slack, 1101 Alaska Commercial Bldg., San Francisco		R. XV, p. 341
Gold King	8	15 N.	13 E.	Jas. G. Dodds, Elizabeth Bell and Nels Forthun, Westville	20	R. XV, p. 340
Great Eastern	20	16 N.	12 E.	Great Eastern Quartz Mine, % J. W. Hyatt, Emigrant Gap	15	
Great Western	31	15 N.	13 E.	Great Western Mining Co., Mr. Kelly, Pres., Martin Winters, Sec., Pier 36, North River, N. Y.	270	R. XV, p. 341
Green	8	12 N.	8 E.	Wm. Kendall, Dutch Flat		R. XII, p. 209; XIII, p. 280; XV, p. 341
Green Emigrant	29	13 N.	8 E.	R. A. Nicol, 67 Sunshine Ave., Sausalito	10	
Hancock & Watson						See Dewey & Stocker
Hannaman				G. B. Hannaman, Auburn	120	
Hathaway	18	12 N.	8 E.	John E. Noia, Newcastle	24	R. X, pp. 429-431; XIII, p. 280; XV, p. 341
Herman	29	15 N.	12 E.	James Maxfield, et al., 2619 Wilshire Blvd., Los Angeles	1,448	R. VIII, p. 472; IX, p. 29; XII, p. 211; XIII, p. 280; XIV, pp. 341-342.
Hermit	30	15 N.	18 E.	John Lass, Summit	20	R. XV, p. 342
Hope	17	12 N.	8 E.	George G. Johnson, R.F.D., Box 11, Auburn	11	R. XV, p. 342
Huntville Cons.						R. XIII, p. 281
International	12	13 N.	9 E.	Patrick McInnis, Butcher Ranch		R. XV, p. 342
Joe Dandy				John Lass, Virginia City, and L. D. Heath, Los Angeles		R. XV, p. 342
Julia	3	15 N.	11 E.	J. D. Sullivan and A. P. Crittenden, Towle		R. XIII, p. 281; XV, pp. 342-343
Julian	7	12 N.	8 E.	Mrs. Martin Schnabel, Newcastle		R. XII, p. 205; XV, p. 343
Kittler Cons., et al.	7	12 N.	8 E.	Clara Volheim Rogers, R.F.D. 3, Box 205, Chico	38	R. XIII, p. 382
Lady Bedford						See Rip Van Winkle
La Follette	7, 8	15 N.	13 E.	Estate of Henry Snyder, Grass Valley	20	R. XV, p. 343; XXIII, p. 249
Langstaff & Storey						Pre. Rep. 8, p. 32
La Trinidad, et al.	34, 2	16 N.	13 E.	Carrie Judd Montgomery, 3835 Buell St., Oakland		R. XV, p. 343
Liberty	30, 31	15 N.	14 E.	C. W. Cross; Wm. Maguire, Nevada City		
Little Banner	22	12 N.	8 E.	Charles Glover		R. XV, p. 343
Little Ginger	33	15 N.	9 E.	D. B. S. Wilcox, Box 272, Colfax	18	
Live Oak	23	14 N.	9 E.	Geisendorfer Estate, Weimar	80	R. XV, pp. 343
Lizzard Cons.	8	12 N.	8 E.	Helen and P. A. Rowe, 150 Post St., San Francisco	19	
Lost Emigrant	32	16 N.	14 E.	Lost Emigrant Mng. Co., % Howard Pascoe, Franciscan Hotel, San Francisco		R. XV, p. 344; XXXI, p. 18
Lundquist	16	12 N.	8 E.	Mrs. Lundquist, Auburn		R. XIII, p. 282; XV, p. 344
Lynn				(Part of Pioneer)		R. VIII, p. 468; See Pioneer also
Malmberg	16	12 N.	8 E.	J. Malmberg, Auburn		R. XIII, p. 282; XV, p. 345

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TABLE OF QUARTZ MINES AND PROSPECTS, PLACER COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Marguerite	3	12 N.	8 E.	Unknown—sold to state		R. XII, p. 210; XIII, pp. 282, 283; XV, p. 344; XVIII, p. 45
Mars Cons.	31	16 N.	12 E.	Sam Wolford, Grass Valley	60	R. XV, p. 344
McAnany	36	12 N.	7 E.	J. S. McAnany, Penryn	64	
McBride	5	15 N.	13 E.	Mary Miller, 2157 15th St., San Francisco	18	
Midas						See Shady Run
Minna Ricca	17	12 N.	8 E.	J. E. Walsh, East Auburn		R. X, p. 433; XV, p. 345
Mitchell				H. F. Adams, Foresthill and Estate of Ben Taber, Auburn		R. XV, p. 345
Monarch Dev. Co., Ltd.	1, 11, 14	13 N.	9 E.	Monarch Dev. Co., Ltd., 500 Call Bldg., 74 New Montgomery St., San Francisco	637	
Mollie or Mollie Stark	21	12 N.	8 E.	Mrs. Asa B. Eastwood, Newcastle		R. XV, p. 345
Moore	17	12 N.	8 E.	J. M. White, Auburn		R. XIII, p. 283; XV, p. 345
Morning Star and Rocky Ridge	17	12 N.	8 E.	H. L. Mooney, R.F.D. 1, Box 1452, Sacramento	35	
Mowitza				Anna D. Tracy, % Mrs. W. C. Wilson, R.F.D. 1, Box 29, Auburn	8	
Nob Hill						See La Follette
No Chunk						R. XIII, p. 284
North Star	22	13 N.	9 E.	E. J. Power, E. J. Young and Henry F. Power, Berkeley		R. XV, p. 345
North Star	34	16 N.	10 E.	North Star Mng. Co., % E. J. Thomas, 564 Market St., San Francisco		
Number Two	10	15 N.	10 E.	E. A. Moody and Mr. Garety, Gold Run		R. XIII, p. 284; XV, p. 345
Ohio						R. VIII, p. 480
Old Pacific	25	12 N.	7 E.	Mrs. Martin Schnabel, Newcastle		R. XII, p. 211; XIII, p. 284; XV, p. 345
Oro Fina	7, 8	12 N.	8 E.	Mrs. Hazel P. Gridley, Auburn	95	R. XIII, p. 274; XV, pp. 345-346; XVII, pp. 445-446; XVIII, p. 7; XXIII, p. 251; Pre. Rep. 8, p. 32
Osborne						See Herman
Ostrom						See Blue Wing
Owl Creek	31	14 N.	10 E.	Mrs. Rosanna Scully, 104 W. Oak St., Stockton, California	190	
Pacific	12	12 N.	7 E.	J. E. Walsh, Auburn, et al.	6	
Pacific Slab						See under Placer Mines
Page and Buckman						See Rip Van Winkle
Paragon						See herein, also under Placer Mines
Patrick Cons.	10	15 N.	12 E.	G. W. Snyder, Damascus		R. XV, p. 347
Pioneer Cons.	3, 4, 10	15 N.	11 E.	Pioneer Gold Mines Co., 519 California St., San Francisco; Burt L. Davis, Pres.; Wm. H. Radford, Sec.	728	R. VIII, p. 468; X, p. 426; XII, pp. 211-212; XIII, p. 284; XV, p. 347; XVIII, p. 302; XXIII, p. 251-252; Pre. Rep. 8, p. 32
Prairie Flower	9	15 N.	13 E.	Henry Snyder, Grass Valley	40	R. XV, p. 347
President Wilson	20	15 N.	12 E.	J. W. Cairns, Weimar	120	

Pritchard Gravel						See Blue Wing
Providence	25	15 N.	10 E.	Providence Mng. Corp., Ltd.	20	R. XX, p. 179
Quien Sabe	9	15 N.	13 E.	Peter Hinst and J. G. Dodds, Westville	40	R. XV, pp. 347-348
Rainbow	25	15 N.	11 E.	Ed Polifka, Michigan Bluff, et al.		
Rawhide Cons.	4	15 N.	11 E.	Canyon Mines Corp., c/o Frank B. Keever, Hotel Sutter, San Francisco		R. XV, p. 348; XVIII, p. 302; Pre. Rep. 8, p. 32
Razzle Dazzle	20	12 N.	8 E.	G. L. Threlkel, Newcastle		R. XV, p. 348
Reciprocity	11	12 N.	7 E.	I. Meyer, Lincoln		R. XV, p. 348
Red Bird Cons.	24	14 N.	9 E.	G. A. Tubbs, Colfax		R. XV, p. 348
Red Rock						See Redstone
Redstone	24	16 N.	11 E.	Paramount Gold Mines Corporation, c/o John K. Wright, 252 S. Main St., Pomona		R. XIII, p. 285; XV, p. 348
Rip Van Winkle	29	15 N.	12 E.	J. D. Dodds, 1614 26th St., Sacramento, and heirs of Ben Buckman	42	R. XII, p. 210; XIII, p. 282; XV, p. 348
Rising Sun	33, 34	15 N.	9 E.	Benj. E. Valentine	18	R. VIII, p. 462; XIII, p. 285; XV, p. 349; XVII, pp. 446-447; XVIII, p. 7; Pre. Rep. 8, pp. 32-33; XXIII, p. 252
Roosevelt	4	15 N.	14 E.	F. L. Heath, Donner, et al.		R. XV, p. 349
Rublin	34	15 N.	12 E.	Messrs. Foley, McCarty & Caren, Chicago		R. XV, p. 349
Ruby	25	14 N.	9 E.	Eddie Hinchey, Weimar, et al.		R. XV, p. 350
Saint Lawrence	7	12 N.	8 E.	Reed Estate, Auburn		R. VIII, pp. 461-462; XII, p. 212; XIII, p. 286; XV, p. 350; XXXI, p. 18
Salsic	3	12 N.	8 E.			R. XII, p. 212; XIII, p. 285; XV, p. 350
Secret Town	10	15 N.	10 E.	E. A. Moody and J. E. Everhart		R. XIII, p. 285; XV, p. 350
Senator Gold and Copper				J. W. Cairns, D. M. Kennedy, Weimar, and C. E. Van Giesen, Applegate	80	Field Report
Shady Run	27, 28	16 N.	11 E.	Shady Run Mng. Co., Box 489, Stockton	217	R. XV, p. 350
Sharron Cons., et al.	4	15 N.	11 E.	Le Roy F. Pitcher & Kate T. Woolsey, 1984 Park Grove Ave., Los Angeles	57	
Sheridan						R. VIII, p. 468
Smith & Fulweiler						See Salic
Snowbird	21	15 N.	11 E.	Jack Starrett, Roseville	20	R. XVII, p. 447; Pre. Rep. 8, p. 33; XXIII, p. 252
Snowflake						See Prairie Flower
Southern Cross	4	15 N.	11 E.	Mrs. K. T. Woolsey, c/o Trimble De Roode, 15 Murray St., New York City		R. XII, p. 212; XIII, p. 286; XV, p. 350
Spanish	7	12 N.	8 E.	Reed Estate, Auburn		R. XIII, p. 285; XV, p. 351
Spanish	25, 26, 30, 31	14 N.	11 E.	Mrs. E. A. Garrison, Foresthill	143	R. XXIII, p. 252
St. Lawrence	7	12 N.	8 E.			R. VIII, pp. 461-462; XII, p. 212; XIII, p. 286
Sterrett						See La Trinidad
Suckers Revenge	2, 3	15 N.	11 E.			R. XVIII, p. 301; XXIII, p. 249; XXXI, p. 18
Sumpter						R. VIII, p. 475
Tahoe Treasure	11, 12, 13, 14	14 N.	16 E.	Tahoe Treasure Cons. Mines, Harvey Winslow, Bend, Oregon. Schreck & Morse, attorneys, Capital National Bank Bldg., Sacramento		R. XXXI, p. 18
Texas	20	16 N.	12 E.	Halsey Estate, Towle; J. L. Gould, 1450 Middlefield Road, Palo Alto, Pres.		R. XIII, p. 286; XVIII, p. 263; XV, p. 351
Texas Hill	20	16 N.	12 E.	M. McCormack, 3016 43d St., Sacramento, et al.		

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TABLE OF QUARTZ MINES AND PROSPECTS, PLACER COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Texas Hill Ext.	20	16 N.	12 E.	J. L. Gould, 1450 Middlefield Road, Palo Alto; Fanny H. Politea, Gold Run; Towle Estate Co., 304 Bank of America Bldg., Berkeley	12	
Three Queens				M. Savage, Foresthill		R. XXIII, pp. 250-51
Three Stars	2	12 N.	7 E.	Apphia Vance Morgan, 408 Blair Ave., Piedmont		R. XV, p. 351; XII, p. 206; XIII, pp. 276-277
Tiger, Buena Vista and Ruby	25	14 N.	9 E.	Eddie H. Hinchey, Weimar	62	R. XV, p. 351
Tryon	1	15 N.	10 E.	Dr. W. M. Tryon, 409 Pacific Bldg., San Francisco, & W. N. West, Towle	24	
Two Orphans	30	13 N.	8 E.	B. A. Fredericks, Auburn	21	Field Report
Tyler						R. XV, p. 351
Van Avery	14	16 N.	11 E.	L. Balliet, San Francisco		R. XV, p. 351
Van Giesen	10	13 N.	8 E.	C. E. Van Giesen, Applegate	41	Field Report
Victory	13	15 N.	9 E.	H. E. Loufek, J. E. Johnson, et al.		R. XXXI, pp. 18-19
Washington	30	14 N.	11 E.	Jack E. Nihill, Alleghany		R. XV, pp. 351-352
Westlake	14	Mi. SE.	of Cisco	M. Westlake		
White Oak	14	11 N.	10 E.	J. N. Barton, Jr., Estate	80	Field Report
Wubbena	32	16 N.	14 E.	Herbrant, Eustice & Co., Woodland		R. XV, p. 352

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GOLD PLACER MINES

Little definite, written history of the early-day shallow placers remains, except in the names of numerous bars along the American River, where many mining camps, some of them once containing several thousand people, have disappeared. Wherever it was possible to do so (and few obstacles seemed too great to the pioneers) the waters of the main river, and of the North and Middle Forks upstream from their junction just east of Auburn, were turned from their beds to permit gleaning the harvest of millions of years concealed in these great sluices. This river mining, beginning in the 1850's after the exhaustion of the exposed gravel, had been nearly finished by 1880, when the Boles and McBride Mine was the only producer reported. A few river projects, notably the working of Mammoth Bar by hydraulic elevators, were carried on afterward. In later years a few dredgers, all now out of commission, have been operated successfully on the river. For the most part, however, the bars and beds of these streams are not adapted to working by bucket dredgers, drag-line or mechanical shovel outfits because of the hard bedrock, and large boulders. Farther downstream in Sacramento County, where the American River left the rocky canyon and entered the valley, the richness of its gravel is attested by the heavy production from the dredging fields of Folsom and Natoma. Several places on the main river have been prospected by divers but none of these have found gravel rich enough to pay for mining by this method, with which unit costs are necessarily high.

Following the exhaustion of the surface placers came the tracing, prospecting and intensive exploitation of the ancient river-channel systems, forming a complex network below hundreds of feet of volcanic muds and boulders. In extent and richness, the deposits of this kind worked by drift mining under the Forest Hill Divide have been equalled by no other section. The lava covering of this divide, which separates the North and Middle Forks of American River, extends from the canyon of the Middle Fork five miles southwest of Forest Hill for an air-line distance of 23 miles to Secret Canyon, where erosion in Tadpole Canyon separates it from the gravel of Canada Hill, elevation 6500 ft., and almost on the summit. South of Canada Hill, in Duncan Canyon, are a number of short, steep channels of local character, which have derived gold from nearby veins on the slopes of Duncan Peak. Coming into the Duncan Canyon drainage basin from French Meadows is a large channel about which little is known, although it can be seen where Duncan Canyon crosses it, and has been worked a little.

Drift mines have been worked along the entire length of Forest Hill Divide, and the region was noted in the 1860's as having been highly productive.

Besides this complete river channel system (having in places two or three channels directly above one another), attention must be given to the immense bodies of exposed gravel in the Dutch Flat and Gold Run districts, which are linked with the deposits in Nevada County; also to the Iowa Hill drift and hydraulic gravels, as well as to the old mines at Yankee Jim, where hydraulic mining began in this county in 1852.

Several interesting and valuable general reports have been published upon the courses, geology and correlation of the different channels. Due to the extensive post-volcanic erosion, long sections of the ancient rivers, which had been covered by andesitic mud and boulders, have been removed and re-concentrated by the present streams, in canyons sometimes 1000 to 2000 ft. below the original surface of the andesite. It is often difficult to correlate the remaining segments of channels. This can best be done by comparing characteristics revealed by actual work upon them. Some of these criteria are the fineness, color, size and coatings (if any) of the gold particles; the nature of the rocks forming the gravel and boulders; the presence or absence of some certain rock such as a highly colored quartz or jasper; the character of the volcanic ash or boulder beds which accompany the channel; and the difference in elevation of bedrock at various openings.

The most ancient of the trunk streams are often wider, more uniform in grade and in gold content (though not necessarily richer) than any of the later ones. Such channels have sometimes been worked successfully for miles as at the Hidden Treasure Mine. They are often characterized by immense quantities of quartz cobbles and boulders, due to the long continued erosion of the surface of the Cretaceous peneplain. The rhyolite ash flows which initiated the long series of volcanic eruptions, covered these stream deposits but were not in sufficient volume nor did they continue long enough, to blot out the drainage, so that inter-rhyolitic channels were at times superimposed directly over the ancient stream. Such gravels contain rhyolite pebbles and quartz and have a false bedrock and roof of rhyolite.

The later flows of volcanic mud and boulders were of more basic rock minerals (commonly classified as andesite) and of such immense volume as to completely fill and obliterate the mountain canyons. The elevation of the mountains to the eastward had meanwhile become sufficient to give the new drainage system a steep grade, resulting in rapid erosion of the andesite. The resulting channels were of no value unless or until they eroded deeply enough to reach and re-concentrate the gold-bearing gravels of the more ancient streams. This they frequently did, enriching their gravels for a short distance below the junction, so that these sections became profitable to mine.

The late intervolcanic channels, such as some of those found in Duncan Canyon, cut steep and generally narrow trenches in the sides of mountain spurs which must have been high enough to be above the covering of andesite that had already mantled the surrounding country. This bedrock, though not containing many large quartz veins, was nevertheless rich enough in gold-bearing seams and lenses of auriferous quartz to produce profitable gravel. Such buried streams are the counterparts of the present ones in the high mountains. They have waterfalls, followed by stretches of stream bed flat enough to permit gravel accumulation, and sections where the grade was so steep that no gravel remained and the later lava ash closed down directly upon the bedrock.

Morainal deposits, remaining undisturbed as they were dropped by the ancient glaciers, are occasionally seen in the high mountains. These show unassorted angular rock fragments and soil with some gold.

American Hill Mine is four miles south of Secret House on a ridge between Lost and Antone Canyons, tributaries of North Fork of Middle Fork American River. The deposit is presumed to be an upstream segment of one of the channels mined at Last Chance years ago. The principal channel section here is reported 1700 ft. long by 250 ft. wide, with a smaller channel up to 40 ft. wide. The deposit was mined by drifting on bedrock until the late 1880's, with average results reported, but no record remains of that work. Gravel is reported to vary from 10 to 100 ft. in depth. Water is available in Antone and Big Secret Canyons, requiring several miles of ditch in each case.

Pendleton Brothers have been engaged for several seasons digging ditches to bring water to the ground.

Azalea Prospect is in Sec. 22, T. 16 N., R. 11 E., two miles southwest of Blue Canyon. *Blue Canyon Mining and Development Company* carried on prospecting here for many years, searching for a profitable channel deposit under the rhyolite and andesite capping which is a mile or more wide and extends for many miles from south of Towle to near Cisco. The adit was started at an elevation of about 3800 ft. and 589 ft. below the Southern Pacific railroad. It was run in a general northerly direction for 4700 ft. Near the face a raise 200 ft. long (160 ft. vertically) was put up, and W. J. Holmes reported this showed large wash boulders at the top. A drift was run 100 ft. from the top of this raise. Fifty feet below the top, another drift was run about 300 ft. but failed to show gravel. Only small amounts of coarse gold were produced, the last reported being $900 in 1932. No regular channel was found. The reports concerning the property are not clear, but the adit was perhaps too low.

Bake Oven Placer. On North Fork of Middle Fork of American River, 6 miles by trail northeast of Michigan Bluff. About 60 acres of the ground was leased 1933–1935 to Woodruff and Morgan and some hand mining has been done at intervals. The deposit consists of a high bench covered with gravel about 150 ft. above the present stream. Only a little prospecting has been done but the gravel deposit is believed to be 1200 ft. long, with 35 ft. of gravel and 15 ft. of overburden where opened. The small amount of work done gave returns which might pay for ground sluicing or hydraulicking if water were available.

Baker Divide (*Volcanon Mining Corporation*). Over a long period, little work was done on these extensive holdings on the Forest Hill divide east of the Paragon property. On the south, along Volcano Canyon, a lease was given to C. H. McCarthy on the N½ Sec. 20, T. 14 N., R. 11 E. This was subleased in 1929 to Volcanon Mining Corporation, who operated several years in a small way.

A narrow channel, which is reasonably assumed to be the same worked in the Hazard and Weske Mines farther upstream, crosses this leased land from east to west. A length of 1200 ft. of it was worked up to 1884. The next claim east, the Hazard, was worked for about 3000 ft., and from the Weske Mine an incline was run downstream for a reported distance of several hundred feet into the Muir Tunnel claim, also held under lease by Volcanon Mining Corporation.

This company's work consisted of driving a new crosscut adit 290 ft. long through the south rim bedrock to the old workings 600 ft. upstream from the old adit, and thence following the channel upstream. Late in 1932, this work had extended 1000 ft. upstream beyond the old face. The channel was found to be usually 30 to 40 ft. wide, but narrowing in places to 8 or 10 ft. The gravel was from 6 inches to 3 ft. deep. The results of work had not been as good as expected and the yield reported was small. The reason was believed to be the hard bedrock found; the best pay was reported where the channel crossed soft strips. The grade was 30 ft. in a distance of 1900 ft.

Bald Mountain Mine. This occupies the upstream section of the channel worked in the Glenn Mine, between Duncan Canyon and Deep Canyon in the mountains east of Westville. (See map in Report XXI.) Little has been done except assessment work since the 1925 report. Most of the old work was along one rim as sites are lacking for an adit low enough to bottom the channel. Late in 1935, the claims were reported leased to Frederick Vincent, San Francisco. This ground has produced some coarse gold similar to that found at the Glenn.

Big Dipper (*Horman* or *Waterhouse & Dorn* and *Irish & Byrne*). The upstream section of the Morning Star channel, having its inlet on the Gleason Mine in the SE¼ of Sec. 4, T. 14 N., R. 10 E., Iowa Hill district, was worked successfully at the Horman Mine (later known by the names above). Horman began hydraulicking in 1858 and produced up to 1882 between \$100,000 and \$200,000. Thereafter, it was an important drift mine and was in steady operation from 1890 until 1902, producing over \$1,000,000 in that time. The channel was worked downstream a distance of 4700 ft. until a connection was made with the Morning Star mine workings.

The blue cemented gravel in these mines had to be milled. At the Big Dipper, a Bryan roller mill was used first; later 10 stamps were erected. Gravel was extracted through a bedrock tunnel 37 ft. below the channel, with raises into gravel. The original depth to bedrock was about 130 ft. A depth of 6 ft. next to bedrock was mined. Breasts as much as 370 ft. wide were opened, and posts and caps were used 8 ft. apart. Several benches above the main channel were worked on the east side; potholes occurred in the hard bedrock and these also paid well in places. In 1890 the gravel yielded \$9 per carload of 1 ton; the average of that worked was said to be \$6 a ton.

The last work done at this mine was by *Stanislaus Development Company* in 1917–1920. Prospect shafts were sunk and an open cut 600 ft. long by 4 ft. wide and up to 50 ft deep was made, in search of unworked gravel. A few thousand cars of bench gravel which had been left by the previous operators probably because of its low gold content, was mined and milled.

Big Gun Mine. This old hydraulic mine at Michigan Bluff was the largest producer of 20 or more placer claims worked profitably in early days. The present holdings include the Big Gun, Thompson & Powell, (unpatented), Red Hill and Van Emon Placer Mines (patented). Although the Big Gun was worked by hydraulicking regularly from 1854 to 1883 and was a producer at intervals until after 1901, details of output are lacking except for the small-scale operations in which from a few hundred to $8,000 a year was recovered between 1888 and 1901. The production up to 1882 was claimed to have been about $1,000,000. In early days the principal mine of this ground was called the North American and was worked by the Van Emon family. First surface sluicing and then drift mining were begun in 1854. Hydraulicking started in 1858 and in 1860 a bedrock adit 1400 ft. long was run. The introduction of nitro-glycerine at this mine in 1867 for blasting 'pipe clay' which overlay the pay gravel is said to have resulted in as much work being done by 15 men as had previously been done by a crew of 28. The company used 400 inches of water under 300 ft. head. (See also Michigan Bluff Drift and Hydraulic Mines.)

There is remaining unworked at the Big Gun over 2,000,000 cu. yds. of gravel. The old reports do not mention the yield per yard from this mine, so the gross value can not be given.

Big Spring Mine. This adjoins the Dardanelles Mine on the west, and the two claims were so located along the course of the deep blue lead as to divide it nearly evenly. The Big Spring Mine was opened in 1854 as a drift mine and was worked until the late 1880's. Part of the work was done through an adit shared jointly with the Dardanelles Mine, besides which the Big Spring adit was about 1400 ft. long. The total production is not known but up to 1882 was said to have been about $150,000. At one time it had a 10-stamp mill.

Blue Eyes Prospect. This extensive group of claims between Deep Canyon and Spruce Canyon on the west side of Duncan Canyon, was described and mapped in R. XXI, 1925. Since then the work done has not led to any important discoveries, and lately only assessment work has been carried on.

Bob Lewis (*Damascus*) *Drift Mine.* This old mine adjoins the Mountain Gate mine on the east. It contains a cemented blue gravel channel which entered the ground from the north and flowed east of south for 2000 ft. in this claim, along the east rim of the primary white quartz channel mined in the Mountain Gate and Hidden Treasure mines. It eroded away part of the east rim of the earlier channel. This blue gravel was worked from 1860 to about 1885 by the Damascus company and a yield of from $8000 to $10,000 a year was reported in the later years.

The gravel was blue and cemented. It was 4 ft. thick and was worked 150 to 200 ft. wide. The stream had cut the bedrock 35 ft. deeper than in the adjoining white channel, and the gravel carried some large quartz boulders from the earlier deposit. A 10-stamp mill crushed 25 tons a day, which was mined by a crew of five breasters and one carman. The roof stood well, requiring only one post with a cap 30 inches long in each square of 30 ft. The total length of channel worked in this mine is uncertain, although a map published in 1890 indicated about 1100 ft. had been mined.

Burns Mine. Reopening of this old drift mine, one-half mile from Michigan Bluff, was started in March, 1934, by D. Young, J. Simpson and A. M. Dunlop. It had been lying idle for many years, after activity which started in early days. Details of the earlier work are lacking. It was relocated in 1887 and until after 1900 considerable work was done by *Michigan Bluff Mining Company* who had two adits, the upper one 900 ft. and the lower 1050 ft. long. An incline from the upper one reached gravel and between 1895 and 1900 some production was made, but water was reported to have stopped the work. Four unpatented claims held since that time by the old company's stockholders were believed to cover three-fourths mile of a channel which is not known to be connected with any of those worked in nearby mines, but presumed to have run south under the andesite capping.

The present operators cleaned out and retimbered the longer adit and drove a new tunnel about 600 ft. long, where gravel was reported late in 1934. A winze was sunk 67 ft. and preparations for mining were made early in 1935.

Carmack (Pacific Blue Lead) Mine. At Canada Hill about 10 miles from Westville. It was described in Report XV under the latter name. Soon after, it was sold to George Carmack, who did some further prospecting and drilling, as described in Report XVII. The principal work was in an adit reported 600 ft. long, but partly caved so that only 350 ft. of it could be seen at time of visit. Through this adit Harris worked a bench deposit of white quartz gravel 20 ft. by 60 ft. in area and 2 ft. to 4 ft. deep which is said to have averaged $2.50 a car (weight not stated). The white gravel is on the rim of a deeper and later channel which has not been prospected. Carmack sank two shafts in search of it, one 70 ft. deep near the creek below the old workings, and one 75 ft. deep from a point 350 ft. inside the adit mentioned. His death prevented completion of the work. Part of the claims have since been patented by Mrs. Marguerite Carmack, Seattle.

Copper Bottom Mine. This is on the Succor Flat channel upstream from the old Succor Flat mine, 3½ miles north of east from Iowa Hill. The Copper Bottom was credited with the production of $31,400 before 1882, but much of the gravel in it is supposed to have remained unworked. There is reported to be an upper run or bench deposit about 50 ft. above the main channel, on which some work was done in 1922. The deeper channel was reached through an adit 400 ft. and a slope 300 ft., requiring a vertical lift of 120 ft. for water. The length of channel worked is unknown.

Dam Mine. This lies just east of the Hidden Treasure Mine, and while the middle section of the white quartz channel was being worked in that mine, the Hidden Treasure management bought part of the Dam claim along the course of the Dam tunnel and used it to work their own gravel.

The Dam claim contains an intervolcanic channel which is believed by some of those who are acquainted with the area to be the downstream section of the Red Point channel. They claim that this channel did not entirely cross the Hidden Treasure white channel, but followed along its east side and finally turned southeast through the Dam claim. This claim was first worked in 1858, and in the early 1880's the main adit had already been run 2700 ft. At that time it was producing about $1,000 a month and the channel was being worked for a width of 100 ft.

Later it was worked out to the Hidden Treasure line. The data available do not definitely identify this channel with the Red Point channel, which is stated by Lindgren to have "cut through the older white channel of Mountain Gate to a depth of 90 ft. below its bedrock." It can reasonably be connected with the *Bob Lewis* channel, which was mined in the claim of the same name just east of Damascus. This channel followed the east rim of the Mountain Gate-Hidden Treasure channel and eroded it for some distance, at least, leaving the white gravel on a bench to the west.

The Dam channel cut through high bedrock at the south end of the Dam claim. In June, 1934, new work was begun to prospect for gravel which might remain between the section already worked and this high rock on the east. From a point in the tunnel 450 ft. from the portal, a crosscut was run 300 ft. to the high bedrock. No unworked deposit was found during this work, which was stopped in July, 1935, although a little gold was mined while passing through the old workings.

The claim is equipped with two small gasoline engines, a small air compressor and pipe. Besides the Dam claim of 175 acres, there is also a narrow claim 1000 ft. long extending from the tunnel portal down the west branch of El Dorado Canyon, where the dump and sluices are located.

Dardanelles Mine was opened in 1853, and was originally worked as a drift mine, but later also by hydraulicking. Erosion took away the south rim and part of the deep blue channel, permitting the hydraulicking of the entire "front" of the claim. The average height of the bank was 150 ft. and it is reliably reported that 3,630,000 cubic yards was worked by hydraulicking by 1889, with an average yield of 13 cents a cubic yard. In November, 1879, a bank blast of 36,000 lb. of Judson powder, distributed in chambers along a 1000-ft. front, broke down and shattered half a million cubic yards of gravel.

Drift mining was carried on for many years upon the deep blue lead, up to the place where a later volcanic channel is reported to have cut it off. The cemented gravel in the main channel was 5 ft. high and was mined on the average 75 ft. wide. The main channel was divided here lengthwise between the Dardanelles and Big Spring claims, the latter being on the west. It was also an important drift mine. When the Dardanelles adit reached a length of about 2700 ft. where the later channel was encountered, an incline 330 ft. long was sunk to bedrock and considerable drifting done upon this channel. The mine was involved in litigation for a long time, and few details are available regarding the results of the drift mining between 1882 and 1894. In the later work a 5-stamp mill which began work in 1888 was used to crush gravel. Electric power was used for hoisting gravel from the incline, for pumping and for illumination.

Deadwood Drift Mines (*Double O*). Rube Manling and associates of Michigan Bluff have been prospecting for five months (1935) on part of this property, formerly consolidated by *Double O Mining Company* (which company was suspended in 1931 for failure to pay its corporation franchise tax). They are said to have produced considerable coarse gold recently (June, 1935).

In years past many thousand feet of adits have been run to work the ancient channels in Deadwood district. The maps of these workings by which the channels might be correlated with those of the Forest Hill Divide have not been made available to the writer. It is generally supposed that the channels from Last Chance entered the present Deadwood Ridge on the east side at Devils Basin, running west and southwest across the ridge with the outlets exposed by erosion a little north of Deadwood. The channel sections which may have once extended from there westward for two miles to connect with the Hidden Treasure and later channels of the Forest Hill Divide have been completely eroded by Indian and El Dorado creeks. The correlation between the channels of Deadwood and Last Chance on one side and Forest Hill Divide on the other is made by the similarity of the volcanic cappings, and the comparison of grades. The older channel of the series has a grade of 120 ft. per mile for the two miles across Deadwood Ridge. This channel has not been as extensively worked at Deadwood as have the intervolcanic channels. Of the latter, the Rattlesnake channel was worked for about 7000 ft., having a grade to the west of 240 ft. in that distance; and the Elkhorn-Washington channel has also been extensively worked. In the later years of work (1897–1914) practically all the placer claims at Deadwood, including the *Harkness, Washington, Elkhorn, Devil's Basin, Devil's Basin Consolidated, Rattlesnake* and *Lofruth* were held under the ownership of R. Lofruth and J. E. Ferguson as the *Devil's Basin Consolidated Mines.*

Dixie Queen Mine. Since the last report,[1] this mine was worked irregularly by drifting, and during the past few seasons by hydraulicking in a small way. In 1933 Frank Escher made a short run, and since then Davidson Brothers have worked the claim.

The former drift mining was done through an adit driven 800 ft. south along the course of the channel. Breasting was done for a length of over 200 ft. and a width of 55 ft., about 15 ft. above the adit.

Dutch Flat District

The Dutch Flat gravel mining district, covering about two miles in length between Bear River and the Central Pacific Railroad, on the great ancient river deposits which extend north and south through Nevada and Placer counties, was formerly one of the heaviest gold-producing sections of the county. As at Gold Run, where the deposits are on the same old-river system, little mining has been done there lately, although considerable unworked gravel remains. These mines north of the railroad drain into Bear River, where the debris disposal problem became aggravated at an early date. As early as 1867 it was said that tailings from the placer mines there had already accumulated to a depth of 70 ft. in the river, and proposals had been made to drive a tunnel about three miles long through the ridge separating Bear and North Fork of American River to permit sending debris into the latter. Though appearing to promise great profit ultimately, this project was too expensive for private means.

Placer mining began at Dutch Flat in 1849 and hydraulicking on a moderate scale was started in 1857 on the Phoenix, American, Buckeye, Dutch Flat and Queen City claims, although some piping was done as early as 1855 on the Teaff and Boston claims. Most of these claims were small, and used only 200 to 300 miners inches of water each, but the yield was high. A production of $150 a day was apparently the average for a claim using 250 inches of water and employing four to six men. By 1868, most of the upper, easily washed gravel was worked off. Drift mining began in 1856 and several claims, including the Blue Cut, Potosi, Whynot, and Badger paid well for years, the Badger being credited with dividends of $192,000 in four years. In 1867 the first shaft was sunk to bedrock on the Buckeye claim, giving flattering prospects in the blue cemented gravel. The first mill for crushing this cemented gravel appears to have been put to work the same year on the Ohio claim. Subsequently most of the bedrock of the deep blue lead between Dutch Flat and the railroad is said to have been worked by drifting. The detailed history of none of these claims is to be had in available publications, and only a few were described in contemporary reports. Most of them were unpatented, and in later years were relocated under other names. The mines of the district do not appear in the lists of producers for many years after the anti-debris injunctions until 1895, when the *Southern Cross* and *Polar Star Mines* worked alternately both by drifting and hydraulicking, were credited with small outputs. They continued active until after 1900. In 1900, the *Polar Star* was using 2800 inches of water under 450 ft. fall, with 8-in. and 9-in. nozzles. There was only sufficient water to permit work five hours daily with two nozzles of these sizes in the spring of that year. This work was done in the cemented, coarse gravel in the lower part of the channel. A log crib debris dam in Bear River was used jointly by this mine and Liberty Hill mine in Nevada County. Drift mines that were active about the same time were the Dutch Flat Blue Lead, working in the bottom cement gravel which was crushed in a 10-stamp mill; the Alta Mine and the Bartley Consolidated, on the branch channel coming down from Alta, on the east side of Little Bear River. Both of these produced low-grade gravel, considered from the drift-mining standpoint.

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[1] "Ancient channels of the Duncan Canyon Region, Placer County," R. XXI of State Mineralogist, 1925.

The main deep channel between Indiana Hill and Little York in Nevada County has bedrock which rises 100 ft. in a distance of four miles from the south end to the town of Dutch Flat, but in spite of this, it has been considered by many that the stream flowed north. Near Dutch Flat railroad station it turned from its previous northerly course to the west, crossing the present Bear River about one mile west of Dutch Flat. Smaller channels entered the district, one from Liberty Hill in Nevada County running through Elmore Hill, the Polar Star and Southern Cross Mines and under the town in a southerly direction. The upper gravels in this were fine or medium but on and near bedrock many heavy boulders were found. Another channel entered from Alta through the Bradley & Gardner, Bartley and Mutual claims. In the main channel, having a depth of around 300 ft., the lower part was of coarse blue cemented gravel 100 to 200 ft. deep. In the branch channel from Liberty Hill, the coarse, cemented bottom gravel left after early hydraulicking at the Polar Star and Southern Cross was from 60 to 160 ft. deep. The total superficial area of gravel at Dutch Flat was about one square mile.

Jarman in his report to the State Hydraulic Mining Commission (1927) estimated that if the channel trough maintains the same cross-section here as at Gold Run and Bear River, there remains about 34,573,000 cubic yards of gravel. It has been estimated[1] that in all 105,000,000 cubic yards have been washed at Dutch Flat, Nary Red and Elmore Hill. This was mostly top gravel, though work was carried to bedrock in pits on the Southern Cross and Polar Star. William Nicholls, who did this deeper hydraulicking, estimated that where the deep ground had been previously drifted it produced 25 cents a cubic yard by piping, and where not drifted the yield was 40 cents a cubic yard. In some of the later drifting at a nearby claim, a thickness of 15 ft. next to bedrock was said to give from 90 cents to $2.50 a carload (presumably one ton).

The total production of the Dutch Flat mines can only be guessed. Writing in 1867, J. Ross Browne stated the shipments of gold for the first six months of that year from Dutch Flat totaled $307,600 and said that in 1858 ''the monthly gold yield was thrice as great as now.'' The camp was one of the leading hydraulic producers for 12 years before 1867, and had a record of a dozen or more small mines which had been in steady operation every season for periods of from 6 to 12 years, producing $100 to $200 a day (gross) each for 6 to 8 months annually. The figure of over $3,000,000 production at times credited to the district therefore seems too low, and $4,500,000 to $5,000,000 is probably much nearer the mark.

Dutch Flat Townsite. In 1933, Francis G. Fabian and associates of the *Enterprise Leasing Company* obtained mining rights under a number of lots in the town of Dutch Flat, as well as under school property and the streets, for the purpose of prospecting the unworked gravel deposit on which the town was built. A shaft was sunk about 125 ft. and considerable drifting was done in 1934, with a production of less than 100 ounces of gold reported. In 1935 these parties quit the project, and in August, 1935 Lyman Gilmore and associates were reported to have filed a mining location on the deposit, or so much thereof as had been excluded from the grant made in 1867 for the townsite.

There is a mill and other machinery which was placed on the property by the former operators. The *Federal Drift Mining Company* as late as 1915 prospected the deposit through a nearby shaft.

El Dorado Drift Mine. This old mine at Startown, one mile from Last Chance by trail, has been worked only in a small way in late years, though formerly the largest producer of the district. The geologic conditions revealed here underground are very interesting and have apparently never been adequately described. Work began in the 1850's and the most of the production was made before statistics were regularly kept.

Three channels occur in the property, lying almost directly above one another. The lowest and youngest is the El Dorado channel, but the Sharpstick channel lying 9 ft. above it was first worked for 3000 ft. to where it was cut off by the El Dorado channel. The former channel has a pipe-clay roof and carries large boulders. El Dorado channel was a steep, narrow mountain stream from 10 to 100 ft. wide, but usually being under 25 ft. wide. It carried a scanty amount of gravel, which is absent in places, where the andesite is in contact with the hard schist bedrock. Pay was found in this channel near where it cut the older one. Gold in it is coarse and nearly all in crevices in the bedrock. The main tunnel followed it 5200 ft. At a point 4500 ft. from the portal the El Dorado channel branched, and a branch drift was run on the left fork, northeast, for 900 ft. The general course of channels is southeast and the bedrock rises about 125 ft. going from the portal to the face of the left fork of drift, a distance of 5400 ft.

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[1] House Executive Documents 2d Session, 51st Congress, Vol. 36, pp. 83–86, 1891.

The Big channel is 42 ft. above the El Dorado channel and was cut off twice by it. This channel has a maximum width of 800 ft. and has been worked through raises from the El Dorado tunnel for a length of 1800 ft. in this property. The gold content was found to be spotted, but generally low, and the gravel was partly cemented.

Other important old mines in the district are the *Pacific Slab,* 1½ miles southwest of Last Chance, where the Big channel was found to be cut by a later one 3500 ft. underground; and the Home Ticket, described herein.

Excelsior Claim had the first shaft sunk near the middle of the lava cap, one-half mine west of Forest Hill, in search of the main deep channel. This struck bench or rim gravel, and the company installed a steam power plant for hoisting and pumping, and a mill for crushing gravel about 1880. Unlike the Mayflower Company which put down a shaft shortly after from their old hydraulic pit to gravel on the same west rim a mile and a half upstream, and then began a long bedrock tunnel to bottom the deep gravel, the Excelsior operators sank an incline called the Excelsior slope, from which considerable production was made until they were driven out by water.

On the *Independent* claim, next upstream from the Excelsior, an incline was also sunk, but in this case from the southeast rim. This bottomed the channel at 2696 ft. elevation, not far from the foot of the Excelsior slope. The two claims together had less than 1000 ft. of channel. The section of this deep cemented channel upstream from the Independent Slope in the *Independent, New Jersey* and *Jenny Lind* claims (*Jersey Consolidated*) was not opened until 1915, when a new company, *Excelsior Gold Mines Company* obtained control of the claims by buying control of *Reamer Consolidated Mining Company,* which had held the claims for many years. Between October, 1915, and February, 1918, a total of $253,817 in gold was produced by Excelsior Gold Mines Company of which $212,123 was reported as coming from the Independence, New Jersey and Jenny Lind claims, where about 1200 ft. of channel was worked. Stockholders of the Reamer and Excelsior companies had a lengthy dispute regarding the accounting for proceeds of operations, and many details are lacking. From what can be learned, however, this gravel must have yielded about the same average gold return as in the Mayflower, i.e., $7 to $8 a ton. It was said to have been much richer in places.

The work was done through the New Hope tunnel, with its portal in Sec. 35 and running upstream in bedrock below the gravel. This tunnel was 4786 ft. long when it reached the Garland Mill Slope claim; how much farther it was run in that claim is not known by the writer.

It permitted draining the Excelsior and Independent Slopes and the working of the channel thence upstream through raises, from which breasts were opened for a width of 100 to 150 ft. in the Reamer Consolidated claims. Excelsior Gold Mines Company quit work in December, 1918, and it was reported then that they had "lost the paystreak." In 1919–1920 Haines Gridley as trustee did considerable more work, amounting to over 1000 ft. and advancing about 400 ft. upstream, giving a total length of a mile or more. He reported low-grade gravel, with the rims far apart. Since then, work has been intermittent and production small.

It was in the claims discussed (Independent, New Jersey and Jenny Lind) under the town of Forest Hill, that the pioneer miners found exceptionally rich gravel in the Forest Hill channel, a primary stream deposit of which about one mile in length, flowing west through the west half of section 36 and east half of section 35, remained between the canyon slope and the deep blue lead. These claims had made the following reported productions before 1868 from one-half mile of this channel and its benches:

Independence	$450,000	(3500 ft. of tunnel)
New Jersey	$850,000	(from an area 500 ft. by 400 ft.)
Jenny Lind	$1,100,000	

The hope of finding the western segment of this channel, beyond the point where it had presumably been cut off by the deep blue-lead, has been the incentive for much of the work done since the death of J. W. Reamer, a pioneer operator of the Jersey Consolidated. His widow consolidated and held finally all of the claims between the Dardanelles and the Gore claims, including the old Baltimore Consolidated and Forest Hill Slope, which had been sold at sheriff's sale in 1868 to Alvinza Hayward. These claims became the Reamer Consolidated in 1902 and passed, as noted above, to Excelsior Gold Mines Company in 1915, and finally into the hands of W. F. Detert, now deceased.

The Excelsior company in the last operations on the blue cement channel used stamps for crushing the fine gravel and a tube mill for scrubbing the boulders. Large lumps of cemented gravel and coarse pieces of bedrock were crushed in a rock breaker before stamping.

Flora Dean (*Glencoe*) *Mine.* Prospecting on a small scale is carried on irregularly at this old mine north of Roach Hill in Iowa Hill district. In 1935 a raise was being put up in a branch adit about 1300 ft. from the portal of main adit.

The channel on this claim was considered a tributary of Succor Flat channel. In early days the Glencoe mine was credited with a production of $13,400.

Georgia Hill Mines. These old mines, near Yankee Jim on Devils Canyon, were last actively prospected in 1919–1922 by Georgia Hill Gravel Mining Company, Incorporated, which had 757 acres under lease. An adit, designed to bottom the channels and permit drift mining, was run south, starting on the Trafton claim and entering the Kerr claim. At the time of visit in 1921 this adit was 1400 ft. long, and is reported to have been run about 500 ft. farther the next year. At a point 850 ft. from the portal, the adit was directly under the face of the old hydraulic pit, and 175 ft. vertically below the bedrock surface. At 1350 ft. in, a raise was put up 206 ft. and from its top an upper level had been run 22 ft. south and 136 ft. west at time of visit. It was entering gravel carrying heavy granite boulders. The steep grade indicated has been explained by some as due to the raise being put up through a bedrock island in the channel. At any rate, the company discontinued work without making any discovery of good pay. Besides those named, the Buchanan, Armbruster, Gillespie and Adams claims were included in the lease.

Gleason Consolidated Mine. At Wisconsin Hill, two miles south of east from Iowa Hill adjoining the Big Dipper. The Columbia claim, worked by James Gleason as an hydraulic mine, was the principal one of the group, and had made a reported gross production of $350,000 by 1880. The Ravine and Tenyke claims are said to have produced $113,000 more up to that time. For some time after, the ground was worked by Chinese and their output is unknown. The upstream part of the Big Dipper-Morning Star channel was exposed on the Gleason ground by erosion in Refuge Canyon, and the work exploited the main channel and bench gravel. Refuge Canyon, into which the mine tailing was dumped, also produced much gold up to 1897. At the Gleason a bank 220 ft. high was worked, with the main channel about 325 ft. wide, and a much greater width of bench gravel. In later years lessees have made some production. In 1933, the last of these, *Goodman Mining Company,* began producing gold from drift mining and have since been realizing substantial returns, up to the fall of 1935, when four or five men were working.

Glenn Mine has been for many years the principal producer in the Duncan Canyon region, in the mountains six miles east of Last Chance, and reached by 55 miles of road from Auburn. Gold has been produced intermittently since 1919. The channel courses south and southeast from the Bald Mountain mine to Duncan Canyon. About a mile in length lies in the Glenn mine, and the larger part of this has been prospected or mined through a series of adits at different levels, from 5000 to 5345 ft. elevation.

The channel is steep and narrow and the gravel is mostly of hard schist from the bedrock, with little quartz in it. In the lower workings the gravel was 12 to 15 ft. wide and from 0 to 2½ ft. thick, being overlain by coarse volcanic sand, which in places closes directly down upon the hard, polished schist bedrock. The gold there was mostly in the crevices of the bedrock. In the upper workings a width of 35 ft. was breasted. In the Shields tunnel a crevice 22 ft. by 55 ft. yielded $9000. In a length of 1500 ft. in this tunnel the channel raised 140 ft. This included many sheer drops of several feet, which were evidently waterfalls in the old stream, and not faults. In sections with flatter grades gravel accumulated. It is a late prevolcanic channel which collected coarse gold from the erosion of the nearby mountain region, where gold occurs in seams and stringers.

The mine has been worked most of the time in late years by different lessees with small crews. It was active in 1935 and for some years has been producing from $2000 to $10,000 a year.

The mines in this section of the county were described, and a map of the district was printed in our quarterly, 'MINING IN CALIFORNIA,' for July, 1925.

Gold Run District.

The Gold Run-Dutch Flat ancient channel section has been divided by the erosion of modern streams into two sections, separated by the ridge occupied by the Central Pacific Railroad between Gold Run and Dutch Flat. The drainage to the west is into Bear River, and to the east into Canyon Creek and North Fork American River. On the eastern section between the railroad and Canyon Creek, both hydraulic and drift mining were extensively carried on, but although much gravel remains unworked there has been little activity in recent years.

The best estimates of the total amount of gravel mined in this section are necessarily only approximate, as very few of the old hydraulic miners had an accurate idea of the yardage mined. Estimates given by government investigators in 1891 indicate that 84,750,000 cubic yards had been mined. The later and more careful work of G. K. Gilbert in 1908 led him to believe that previous figures for the yardages mined in the American and Yuba River drainages should be increased by 51% and if this correction is applied to the Gold Run district it would indicate a total of about 128,000,000 cubic yards removed.

As a result of the uncertainty concerning the yardage mined, it becomes nearly impossible to arrive at accurate estimates of yield per yard. In 1871, Professor Pettee estimated that 43,000,000 cubic yards mined by hydraulicking up to that time had yielded $2,074,356 or 4.82 cents a cubic yard. This was the low-grade top gravel. The above total production was arrived at by adding 50% (on account of gold thought to have been sold outside) to the amount of gold sold to Moore & Miner, bankers at Gold Run between 1865 and October, 1870. Later figures for production and yardage are conflicting. In 1872 incomplete figures were kept for two companies which do not show yardages handled or duty of water, but from which a yield of from 8 to 15 cents a cubic yard may be estimated by figuring water duty as high as five or as low as two cubic yards per miners inch daily. Lindgren stated[1] "The yield per cubic yard of hydraulic gravel is said to be 11 cents." His report was written after hydraulic mining had been enjoined and the source of his figures is not given. By 1873, these deposits had been worked down to a level where the natural outlets of the upper part of the district were becoming choked with tailings, and work had been started on a drain tunnel from Canyon Creek by *Gold Run Ditch & Mining Company* which with its branches finally aggregated over 4000 ft. in length. Little has been recorded concerning the later hydraulic mining. One run of 60 days made in June and July, 1908, resulted in a production of $64,564.81 from 237,400 cubic yards of the cemented bottom gravel in a place not previously drifted. This was an average of 27.2 cents a cubic yard for a depth of 80 ft., where considerable dynamite and black powder were used for blasting and 2000 miners inches of water under 450 ft. head was employed.

The mining claims of this district, once said to have been worked by about 40 small companies, came in later years under the ownership of a few, of which *Stewart Gravel Mines* has the largest acreage, other owners being *Nicholls Estate Company, J. L. Gould* and *Gold Run Ditch and Mining Company.*

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[1] Lindgren, W., U. S. Geol. Survey, Prof. Paper 73, p. 145.

The cemented gravel or 'Blue Lead,' occupying the deep trough under the deposit of loose and finer material mined by hydraulicking, was worked extensively by drift mining from the south end, where the river canyon exposed the deposit. Hydraulicking at this end, called Indiana Hill, started in 1857 in a small way, but the claim of Indiana Hill Blue Gravel Mining Company was worked from 1854. They erected an 8-stamp mill for crushing the cemented gravel in 1864. For three years, 1872–1874 inclusive, this company produced 19,997 carloads of gravel which yielded $75,422.47 or an average of $4.71 a ton,[1] with a profit of $2.17 a ton. The previous production of the claim was estimated at $125,000. Between December 1, 1874, and August 21, 1875, *Indiana Hill Cement Mill and Mining Company* produced $56,446.47 at an operating cost of $24,000. From 1876 to the end of January, 1879, Indiana Hill Placer Mine produced $152,225.90. Details of later production are not at hand, but the total is reported at $750,000. Details are lacking regarding the numerous other claims worked in the district, mostly by hydraulicking.

The upper beds of gravel in this immense deposit vary from a width of a few hundred to 3000 ft., averaging one-half mile, and with a length of about 12,000 ft., of which about 1000 ft. has been worked entirely to bedrock beginning at the lower end of Indiana Hill, and in the Indiana Hill pit about 1600 ft. long by 2000 ft. wide was worked out completely. In addition, most of the top gravel is gone from the rest of the claims, and the bottom has been drifted to an extent not exactly known. The upper gravel was ideal for hydraulicking, with no overburden nor very large boulders. The maximum depth to bedrock was 300 to 400 ft. There remains unworked in the deposit an amount of gravel that has been variously estimated by different parties as follows:

46,000,000 cubic yards of hydraulic gravel ultimately available. (House Executive Documents, 2d Session, 51st Congress, 1890–91, Vol. 36, pp. 83–86).

92,000,000 cubic yards (estimated, Lindgren, P.P. 73, U. S. Geological Survey, p. 145).

75,000,000 cubic yards (Arthur Jarman, Report of the Hydraulic Mining Commission of California, 1927).

In 1874, Indiana Hill Blue Gravel Mining Company was working the bottom gravel by drifting, through an adit then 1600 ft. long. They were then "carrying forward a 'breast' 110 ft. in width and taking out from 6 to 7 ft. in depth of gravel inclusive of the bedrock picking." They employed 25 men who extracted from 40 to 50 carloads, containing 1600 lb. of gravel each, in 24 hours. This was coarse, cemented blue gravel containing many large boulders. In places a height of 10 ft. was breasted. This deep blue lead has been only slightly prospected between the Indiana Hill drift workings and the railroad, between which places it is believed to be continuous, with a grade of 25 ft. per mile.

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[1] This does not include boulders stored underground.

Golden Fleece Prospect is on the lava-covered ridge between Westville and the Hogsback claims. As at the latter, an adit was run from the north side of the ridge in a southerly direction in search of gravel. This adit was about 3300 ft. long and encountered what was reported to be a bench deposit of white quartz gravel, in which about 1000 ft. of the adit was run. A winze into deeper ground is said to have been stopped on account of water. The course of the supposed intervolcanic channel through this ground has not yet been proved.

Gould Mine. In Sec. 23, T. 15 N., R. 10 E., about 3½ miles northeast of Iowa Hill, in Indian Creek Canyon. The Gould channel which flowed southwest toward the Strawberry Mine, has been prospected for a number of years through an adit with a total of about 2600 ft. of work done. The production has been a few thousand dollars.

In the course of the work two other small channels were encountered named Success and Flying Dutch channels both claimed to be earlier than the Gould channel. The latter was prospected to within a short distance of the line of the Bee claim which lies between the Gould and Penn Valley mines.

Grey Eagle Mine. The intervolcanic channel in this property on the extreme west end of the lava-capped Forest Hill divide near Spring Garden has been prospected extensively through adits from Owl Creek on the north, as described in Reports XIII and XV of the State Mining Bureau. The longest adit was run after a shaft had been sunk 360 ft., and it was supposed this shaft had bottomed the channel. After the adit had been run it was found, however, that the channel had not been bottomed and the adit was too high. This adit was a crosscut for 3000 ft. more or less, and was run 4000 ft. more upstream. The last work was done in 1915–1916 by *California Chief Development Company.* The channel was prospected more thoroughly at this time, and considerable of the cemented gravel was run through the old stamp mill, but the average returns were evidently not satisfactory as the owners quit work soon after.

Hard Climb Prospect. This is reached only by trail from the Glenn or Pine Nut Mines and is on the east side of Duncan Canyon on what is generally identified as a segment of the Chalk Bluff channel which here ran nearly parallel to the present course of Duncan Canyon, which has eroded away much of it. The data on which this gravel is connected with deposits in nearby mines are probably not sufficient to permit a definite conclusion. So far as known, no complete line of levels has been run to connect the various openings. It is quite possible that some of these mines are on bench deposits of earlier age than others, though all are parts of the deposits of the great river that flowed from this section to the Ralston Divide.

At the Hard Climb a number of short adits have been run, varying from 155 to 213 ft. long at time of visit, exposing channel gravel deposited by a stream which flowed S. 37° W. as indicated by shingling of the gravel. The channel is about 300 ft. wide and carries little quartz among the boulders, which are of bedrock material. Over 1000 ft. north of the north adit a shaft was sunk 45 ft. on the west rim. Though the money spent on development has exceeded the amount saved, some of the gravel is said to have yielded as much as $4 a ton (old price). There is a ditch 2500 ft. long but little water is available.

Haskell (Gaylord) Placer Mine. This is 2½ miles southwest of Auburn. The intervolcanic American River flowed through this property, depositing gravel of two different periods. The earlier channel was considerably eroded, so that only remnants in the form of benches remained. Several of these bench deposits, of which the larger were 150, 175 and 325 ft. long, were worked between 1900 and 1906. Few details of earlier work, which was carried on irregularly and in a small way for years, remains. The Haskell Gold Mining Company, owners, quit work in 1897 and later work was done by lessees. The principal pay came from the earlier channel benches. The channels were covered by andesite and the pay gravel was cemented, and was crushed in a Huntington mill. Gravel was breasted to a maximum height of 5 or 6 ft. and a width of from 25 to 150 ft. The total production is claimed to have been over $115,000.

An adit was run 1100 ft. to prospect the deeper and later channel. There seems some doubt as to whether or not this adit reached the bedrock, but according to Lindgren the trough of the channel was followed 500 ft. upstream and was found to be filled with andesite sand, with little gravel, and that of low gold content. East of the road 3000 ft. of work was done through old adits, besides the crosscut run from the deeper adit to work bench gravel. A number of prospect shafts were also sunk upstream east of the bench workings, but no gravel was breasted from these.

Hidden Treasure Mine. This old mine, the largest producer among the drift mines of the state, has been described so many times that it need not be covered in detail here. It was discovered in 1875 by William Cameron. The late date of finding this southern end of the deposit was due to the fact that a late volcanic channel, coming down the ridge from the north on the east side of the primary channel, had eroded away the gravel on the outlet end of the latter, leaving no white gravel exposed. Cameron based his calculations for a tunnel on the elevation of the Mountain Gate workings, on the north end of the channel, and was fortunate in striking the bedrock of the white channel in 600 ft. Thereafter, the mine was worked profitably for 32 years, with a gross production reported as a little over $4,000,000.

The mine was worked on a large scale and became a model of drift mining, with many improvements in practice, and low costs. The earlier work was done through a tunnel with its portal at Sunny South. This tunnel followed the channel upstream, partly in gravel and partly on bedrock for about 8500 ft. It had an average grade of 18 inches in 100 ft. The gravel was loose, free-washing white-quartz gravel on soft bedrock, neither requiring much powder, which was used almost entirely for breaking boulders and bedrock. A crew of 120 men mined and washed 275 one-ton carloads of gravel in 24 hours, at a total cost of 99 cents to $1.10 a ton in 1889–1890, when gravel was being mined 7700 ft from the portal. Two-thirds of the crew were Chinese, who were paid $1.75 a day and are said to have been good miners; white men received $3 a day. Loaded cars ran out by gravity to the dump. Timbering was an important item of expense, because of swelling bedrock. Both the main tunnel and the breasts had to be closely timbered.

Work through the tunnel having its portal at Sunny South continued until 1896, when the quartz gravel was cut off by the later blue gravel channel worked in the Dam Claim. It was soon after that part of the Dam claim was purchased and the site of work was moved into the Dam tunnel with its portal at Centerville. This tunnel was run on the Dam channel to a length of 6000 ft., then run on a slightly steeper grade for 2000 ft. farther, to reach the older channel, the bedrock of which was 32 ft. above that of the Dam channel. The white quartz channel was picked up again 200 ft. beyond the place where it was found cut off by the blue channel. Thereafter, both channels were worked, furnishing from 250 to 350 tons of gravel and 25 to 30 tons of waste a day. The ground was finally worked out up to the Mountain Gate, the tunnel reaching a length of about 10,100 ft. by 1902. Electric power was generated at the property during this later work by utilizing water under 850-ft. head. This power was used for running an electric locomotive which hauled gravel trains of 15 to 30 carloads each, and for hoisting, pumping, etc. To work the blue gravel it was found necessary to sink a winze from the main tunnel, and from these winze workings a width of 150 ft. and a length of 1400 ft. was reported having been opened by 1901, when the blue channel was producing 100 carloads of gravel a day. The white channel widened in this section so much that No. 5 gangway, 7000 ft. north on the main channel, was run west 1100 ft. and then northwest 440 ft. to work gravel on that side. This channel had an average grade of about 70 ft. in one mile. Generally speaking, with exceptions as in the case noted above, it was breasted about 250 ft. wide and 4 to 7 ft. deep including one foot or more of soft bedrock. The yield, and the cost of operation, varied considerably. Gravel carrying as little as 50 cents a ton was washed, but the average gross yield for the first 7700 ft. was $1.75 a ton. The average yield per linear foot of channel is said to have been from $184 to $244. The total amount of dividends is unknown; for 11 years, 1877 to 1887, inclusive, $268,092 in dividends was paid from total receipts of $898,699.43.

Hogsback Prospect. This is 2½ miles east of Westville and is thought to be on the Red Point intervolcanic channel, the nearest workings on which are three miles west of this land.

In the 1890's the Hogsback ground was prospected by three adits driven southeastward from the north slope of the ridge near the west line of Sec. 2, through bedrock. The longest of these adits was run 2900 ft. or more and a raise was put up 152 ft. Some gravel was found at the top of the raise, and an area of 30 ft. by 40 ft. which was worked is said to have prospected well, but according to J. A. Ferguson not enough work was done to learn much of the size of the channel and its possibilities.

Home Ticket Drift Mine. Since October, 1933, parties reported to be connected with *Black Bear Consolidated Mining Company,* a Nevada corporation, have operated this old mine 1¼ miles northeast of Last Chance. It had been extensively worked years ago through an adit nearly 5000 ft. long, from which much breasting was done to a height of 7 ft. along a channel 300 to 400 ft. wide. This previous work, which began about 1855 to 1860 and continued until 1918 in a small way, was stopped when the channel was cut off, and the remaining gravel could not be profitably mined on account of high costs during war time. In 1921, Threlkeld and Davis began sinking an inclined winze from the adit level about 4000 ft. from the portal, in search of a deeper channel thought to underlie the one previously worked. This work was abandoned before completion.

The recent work has consisted of mining and milling cemented gravel left in old mine pillars and on the rim, at places 2000 ft. to 3000 ft. from the portal. Gravel was drilled and blasted with 40% dynamite, and eight men on a shift, including one timberman and one mule driver, were reported to have mined and delivered to the mill 28 to 32 carloads of about one ton each during the winter of 1934–1935. A Krogh gravel mill with a capacity of about 70 cubic yards in 24 hours, is operated by a 25 h.p. diesel engine. This mill has screens with one-fourth and one-eighth inch slots, and about 60 ft. of sluice is used. Water from Grouse Canyon is brought $1\frac{1}{4}$ miles by ditch. The supply runs short in late summer, and only two men were employed underground when visited in August, 1935.

The old production figures for the Home Ticket mine are not available but according to Dave Ray who operated this and other gravel mines in the district for many years, the mine produced about $200,000 before 1920. In 1934, the production of nearly 500 fine ounces put the mine in third place among the placer operations in the county.

Iowa Hill Gold Mining Company. A stock company based on the General Grant and adjoining gravel mining claims in Iowa Hill district, Sections 27, 33 and 34, T. 15 N., R. 10 E. A number of old hydraulic mines along the Indian Canyon front in these three sections were productive before 1880.

This company reopened an old adit and advanced it to a total length of 1600 ft. with a raise 70 ft. into gravel. Work has been going on intermittently for some time, but principally in 1934 and the first half of 1935. In September, 1935, work had been suspended. The gravel is cemented.

Equipment on the property when work was stopped included an 8-ft. Price mill, Dorr classifier, trommel, two Deister concentrators, air compressor direct-connected to a diesel engine, ore cars, tractor, trucks, drill sharpener, electric generator (with diesel power) and several buildings. Less than 1000 cu. yd. of gravel was produced before work was halted.

Jack Robinson Claim. This is one of the Blue Eyes group, bordering on Duncan Canyon just above Spruce Canyon. In 1924–1926 work was renewed on an old adit which had been started in coarse gravel above bedrock some years before. This was run 1300 ft. without bottoming the channel. It is quite likely the same channel found in the Dixie Queen Mine. (See Report XXI, p. 277.)

Long Point Mining Company (Jupiter Drift Mine). The Long Point channel, which ran about southeast through the west half of

Sec. 35, T. 15 N., R. 10 E., then south through Sec. 2, T. 14 N., R. 10 E., in the eastern part of the Iowa Hill district, has been worked for about a mile from the south end. It was mined for a width of about 60 ft. and was spotted in gold content, going as high as $18 a car, or $200 a running foot in places. The gross production was about $200,000. About 1800 ft. of channel was worked under the supervision of Wm. Rose of the *McGeachin Company* about 1909 to 1912.

Long Point Mining Company for several years has been prospecting upstream on this channel. In the summer of 1935 their adit was 3400 ft. long. According to F. Huntington Clark, manager for this company, which controlled at the time a mile and a half of the channel under lease, a volcanic channel had cut below the bed of the Long Point channel above the old workings and had eroded the channel for some distance. In going upstream through this later barren material, remnants of pay gravel were occasionally found, but the channel had not yet been found intact. The work at the time was several hundred feet south of the south end of the Golden Streak claim. Some gold was produced in 1932.

Lost Camp Hydraulic Mine is two miles by road from Blue Canyon, at an elevation of 4300 ft. The channel contains interbedded layers of soft rhyolite tuff and free washing white quartz gravel, and has no soil overburden. The boulders are mostly of quartz and are medium-sized.

The Slums Cut on Texas Gulch on the rim on the northeast side of the deposit is said to have paid well for ground sluicing. The Miller Cut, on the rim on the southeast has an area of about two acres. Boston Cut, on the Blue Canyon side, was also worked over an area of about four acres and a maximum of nearly 100 ft. deep. Some drift mining was done after the cessation of hydraulicking. The work upon the property was done over such a long period and by so many different people that no definite idea of the production is obtainable. The gravel is supposed to have paid for hydraulicking, and at times some coarse gold was found. About one-third mile of channel, 50 to 75 ft. deep, remains. In view of the lack of data regarding the value of gravel, and the fact that considerable of the best pay was taken out by drifting, the amount that may remain that will pay to work by the hydraulic process is uncertain but may amount to several million cubic yards, depending on the width mined.

During 1934 and 1935, a company of Sacramento people have had a crew of men at work preparing this mine for a resumption of hydraulicking. A sluice tunnel has been run and buildings have been erected. Besides a water right claimed in years past on Blue Canyon Creek, water can be purchased for six months in winter and spring from Pacific Gas & Electric Company. There is ample room for tailing storage in Blue Canyon Creek. Some tests of the gravel made in 1934 yielded a few hundred dollars in gold. J. O. Ziegler is president and George F. Buell is in charge at the mine.

Macedon Prospect. This is on the Whiskey Hill channel, next downstream from the Whiskey Hill (Greek) mine, and is one mile south of Secret House. A length of about one-half mile along the channel is presumed to lie in the Macedon. The old Greek tunnel, through which about 600 ft. of the channel in the adjoining mine was worked in the 1880's, was reopened in 1921 and was continued a reported distance of 200 ft. downstream in the Macedon, with a small production. It is a narrow, steep channel carrying coarse gravel and some coarse gold.

Mayflower Mine. The original Mayflower Mine had an area of 370 acres. Over a long period, however, one after another of the old drift and hydraulic mines of the Forest Hill and nearby districts have been absorbed until the present holdings of Mayflower Gravel Mining Company exceed 3000 acres. Among the claims owned are the Texas, Sacramento, Washington, Garland Mill Slope, Excelsior, Hope, Uncle Sam, Green Spring, Live Oak, Small Hope, New Jersey (mineral rights), Brushy Slide, Dardanelles, Oro and many less well known. Several of these were important producers and have been described in past reports, to which reference should be made.

Mayflower Mine was worked first by hydraulicking. Later it was an important drift mine, working the same channel as the bottom lead in the Paragon, with which workings the Mayflower drifts finally connected about 1897. The principal production, about $1,600,000, was made between 1888 and 1899 inclusive. The gravel ranged from 2 to 14 ft. thick, is said to have yielded an average of $7 a ton, and was worked for an average width of 75 ft. It was cemented and was crushed in a 20-stamp mill which had a capacity of 6½ tons per stamp-day, using 850-lb. stamps dropping 100 times a minute. The battery screen was iron plate punched with holes 0.2 inch diameter, and in place of amalgamating plates grooved boards were used in front of the stamps, with quicksilver in the grooves.

The Mayflower operators worked downstream on the bottom or main lead to the boundary of the Garland Mill Slope claim (then under other ownership), as well as upstream to the Paragon line. The amount of work done on the upper lead, 150 ft. above the bedrock of the main channel, is not known to the writer, although at one time it was supplying considerable gold.

Some interesting figures for the Mayflower were quoted by John Hays Hammond. From December 11, 1888, to September 24, 1889, a total of 33,787 tons of gravel was mined from a length of 1620 ft. of channel and yielded on crushing $272,616.50 or $8.06 a ton.

McGeachin Placer Gold Mining Company, Sacramento. This company owns a number of the placer mines of the Iowa Hill district, including the *Jupiter Consolidated, Irish and Byrne, Winchester, Schmidt, Insolvent and Dolly Varden, Morning Star, Pritchard, Hazelroth* and others less well known with a total of 1684 acres shown on the assessor's rolls, as well as the Grizzly or Big Dipper, Zurmublen, Union, Iowa Hill Canal and Lower Humbug ditches, and a reservoir site of 73 acres in Secs. 16 and 17, T. 15 N., R. 11 E.

Although many of the mines named were formerly leading placer gold producers, the present company has done little mining in late years. From time to time lessees have done some work and produced small quantities of gold; the last of these noted being *Long Point Mining Company,* who for some time were engaged in a search for the pay streak in the unworked portion of the Jupiter or Long Point channel. This company made some production in 1932, and in 1933 found enough gold to encourage further prospecting in the hope of again encountering gravel such as made the Jupiter locally known for a time. (See Long Point Mining Company.) Some of the leading mines mentioned above are described elsewhere in this report.

Michigan Bluff District.

Michigan Bluff Hydraulic and Drift Mines. On the canyon front near this town a remnant of the primary white-quartz channel of the Forest Hill Divide was left which was worked first by drift mining and then by hydraulicking from 1853 steadily until injunctions stopped this form of mining without dams in the 1880's. Some work was done as late as 1900 in a few of the mines, particularly in the Big Gun. The greatest activity, however, was before 1870. Between 1853 and 1858, gold shipments were as high as $100,000 monthly. In 1866, the county assessor estimated the output of this camp at $400,000 for the year. In 1869, with 20 companies operating, the total production was $108,600. From an area of about 40 acres, most of which has been worked, it has been estimated that 6,000,000 cu. yd. was mined, which yielded a total of about $5,000,000. The Big Gun Mine was reputed to have produced $1,000,000 up to 1882, and still has considerable gravel.

The deposit was almost entirely of white quartz in the form of sand, gravel and coarse boulders. There was a remarkable number of large quartz boulders of all sizes up to 20 tons. The maximum depth of gravel is said to have been 80 ft. and the average depth 40 ft. If this average is correct, the total yardage mined from 40 acres could not have been half the estimated 6,000,000. It is probable, as is usually the case with such round estimates, that both figures of yardage and yield are in error. But there is no doubt that the camp was one of the most profitable from the standpoint of unit yield. Two men in one case took out 1200 ounces of gold by drift mining in one week. On another claim, an area 100 ft. long and 30 to 40 ft. wide produced $30,000. On the Franklin claim, 2000 sq. ft. produced $37,000 from drifting. The yield per man employed was said to have been commonly from twice to several times the wages paid in the later work.

Monumental (Oriental) Mine. This is in Canada Hill district, 24 miles from Forest Hill and at an elevation of about 6000 ft. The deposit is of angular local gravel, slightly cemented, containing little quartz, and probably is largely morainal. About 2000 ft. in length all told was worked over a long period of years up to 1920, on a channel reported 80 ft. wide running N. 60° W. Work was stopped when the pay was lost, presumably by faulting. Later prospecting consisted of sinking three shallow shafts, the deepest 57 ft., through the volcanic ash overburden. These did not show gravel, and the adit was caved at time of visit, preventing inspection. Gravel was reported spotted in gold content, some being of good grade. It was sufficiently cemented to require working in a small mill.

Morning Star Drift Mine. This was the largest producer among the drift mines of the Iowa Hill district. The channel flowed west through the claim and was eroded by Indian Canyon just east of the town of Iowa Hill, the westerly segment, with its benches underlying the townsite where it was hydraulicked. The portal of the Morning Star drift workings and the mill were just east of Indian Creek. The channel was followed eastward and upstream about 4800 ft. where connection was made with the Big Dipper workings.

This mine was worked off and on from 1854, but the larger part of the output was made by Morning Star Drift Mining Company from 1886 to 1901. In that period, $1,500,000 in gold was produced. The total production previous to that time is unknown, but up to 1881, it was stated the mine had yielded $250,000.

The channel here was reported to have an average width of 200 to 300 ft. It was one of the few mines in which gravel was systematically blocked out and measured before extraction; the tunnel had already been run 2600 ft. by 1888 and 73,629 cubic yards of gravel was blocked out before heavy production started. It was estimated that one-third of the above yardage was boulders and waste. Pay also extended as much as 18 inches into the slaty bedrock. Gravel was breasted 7 ft. high and on account of the cemented roof only posts and caps were required. As in the case of the Big Dipper, the tunnel was in bedrock below the gravel channel, which was worked through raises. The gravel was fed by hand to a 10-stamp mill fitted with a screen punched with one-fourth inch holes. About 90% of the gold saved was in the mortars and 10% in the broad apron sluices outside which took the place of the usual plates. The first 10 months' run by this company 1859 tons, yielded $11 a ton. The average for the mine was reported to be about $7 a ton. The mine paid 103 dividends averaging $4 a month per share; cost of operation was reported to be about $3 a ton.

Mountain Gate Mine. This old mine at Damascus covered the inlet of the prevolcanic, white-quartz channel which flowed south through the Hidden Treasure. Work began in 1852 on some of the claims later included in the Mountain Gate. The original Damascus drift mine, later called the Bob Lewis Mine, was upon the cemented or blue gravel channel lying just east of the white channel. The Damascus company ran a mill for some time on the cement gravel, and a length of about 1000 ft. was worked. This cement channel had eroded away part of the east rim of the white channel.

The main prevolcanic channel was mined for a length of 5400 ft. with a production of $600,000, or $111 a linear foot. The gravel was loose, white quartz gravel as in the Hidden Treasure, easily mined and washed but requiring considerable timbering. It was 300 ft. wide, was breasted 5 ft. above bedrock and yielded over $1 a ton. It was worked principally by the owners, of whom there were originally 16. Water was troublesome as they worked downstream, and finally at about 5400 ft. they encountered a trough cutting across the white channel. On sinking through this, they encountered cemented gravel. Another tunnel was then started, and in turn proved too high, as the preliminary work on the cement channel had not bottomed it, and it finally had to be worked through an incline. This deeper channel, generally considered the same as the one worked in the Red Point Mine, is claimed to have produced $175,000 in the Mountain Gate Mine. After the lapse of so many years, during which no detailed record of mining operations was kept, it is impossible to definitely state the relationships of the Bob Lewis, Dam and Red Point channels, all of which were later than the

Gravel bank at Paragon Mine, Placer County, at the site of slide which buried monitors and pipe and killed one man in May, 1935.

white channel. Doubts that the Red Point channel cut clear across the ancient valley of the white channel and continued westward have been strong enough to induce prospecting for its down-stream section on the east side of the white channel in two places. So far this work has not given positive results.

New Basil Mine. It is an old drift mine probably on the Whiskey Hill channel, two miles east of Westville. A shaft was sunk to bedrock just east of Black Canyon in 1882 and work was carried on intermittently until 1896. About 700 ft. of the channel is reported to have been worked upstream from the shaft. It is a narrow and steep channel, up to 60 ft. wide, carrying coarse gravel and some coarse gold. The details of production are lacking, but it could hardly have been profitable under the conditions.

Occidental Drift Mine. This old mine in Iowa Hill district lies upstream from the Morning Star on the Grizzly Flat channel, being separated from the latter mine by the Julia claim. The channel was worked from the inlet downstream by an adit about 3000 ft. long, which lost bedrock about one-half way in, and was continued in the filling above the trough the rest of the distance to about the north line of Sec. 3, T. 14 N., R. 10 E., where a winze was sunk. This had not bottomed the deep trough when the last report was published on the mine in 1890. It was said it showed the bedrock sloping west 40°.

During the summer of 1935 a prospect shaft was being sunk on the northwest side of this claim near the line of the Julia claim. It was 130 ft. deep in September.

Paragon Mine. J. F. Thompson, owner, Forest Hill. Lessee, *Alanta Mines, Incorporated,* 6518 Selma Avenue, Hollywood. King G. Gillette, president.

This is a consolidation of Paragon Placer, Wm. Rousch & Company Placer Mine, Hosmer, Rosedale, Nip & Tuck, Sebastopol, New York Placer Mines and Paragon Extension Nos. 1, 2 and 3 placer claims, including 800 acres of patented land in Secs. 13, 18, 19, 30 and 31, T. 14 N., R. 11 E., two miles from Forest Hill at the former site of Bath.

Several of these mines were independent producers for years. The original Paragon claim had a frontage of 250 ft. and extended a mile and a half through the hill, with a width of 400 ft. at the back. It was first worked in 1852, and for 10 years apparently only by sluicing; because of the cemented character of the gravel, it had to be washed seven times during which a total yield of $10 a ton was reported. This gravel was described as ''rusty gray gravel, four feet deep resting on blue gravel 100 feet deep.'' Mining was done through an adit run in the blue gravel 20 ft. below the pay streak and breasts were opened across the entire 'front' or width of the claim, with chutes 30 ft. apart to drop gravel to the adit. Finally a 'frontage' of 1600 ft. (length along the channel) was worked in this way. In 1864 a stamp mill was erected.

Complete figures of the mine's production are not available, but according to reliable contemporary reports, the output up to 1871 was $750,000 and for the five years, 1865 to 1870, the annual output did not vary $5,000 a year from $100,000. Hydraulic mining replaced drifting soon after and in 1874 the mine was being worked on a large scale, a bank-blast of 17,500 lb. of powder having been fired that year. For six seasons, 1874–1879, the gold production was $243,075.87 of which $119,670.14 was paid in dividends. Drift mining from September 19, 1879, to April 14, 1880, with 40 men working, produced 4241 carloads which yielded $44,835.53 upon milling, or $7.05 a ton. From 1888 to 1901 inclusive, the production was over $500,000. Thereafter, some production was made by lessees, but the amount was never properly recorded. For the past three years some production has been reported annually, from drift mining in 1932 and from hydraulicking by the present lessee in 1933 and 1934. Taking the figures quoted in the Tenth Report of the State Mineralogist for the production up to August, 1890, which was given as $2,250,000 and adding the recorded output up to 1902, we have a total of $2,651,000 from which dividends of $600,000 are reported.

The geology of the mine has been covered so many times that it need not be repeated in detail. The Paragon upper lead, 150 ft. above bedrock, paid for a width of as much as 350 ft. but averaged 225 ft. wide and 5 ft. thick. It was 'picking ground,' requiring close lagging, and is said to have yielded $4.50 to $5 a ton car. It was worked as far as the main road two miles east of Forest Hill, where it was cut by the Orono channel. This was worked for 1250 ft. upstream and 200 to 250 ft. downstream from this junction, on this property. It cut nearly to bedrock of the main channel. Few details are at hand concerning it. Its reported width is 225 ft. but it is not believed to have paid except in spots. The bedrock or main channel was worked by adit for the entire length of the Paragon holdings, connecting with the Mayflower workings which were driven upstream on the same channel. In the Paragon, a width of 40 to 50 ft. and a height of 7 ft. was breasted. It yielded at times from $25 to $50 per carload of 1½ tons; in 1882–1883 the average yield was reported as $31 a carload and in 1888, $9 a carload. This gravel was cemented, requiring crushing in a 10-stamp mill which handled 40½ tons in 12 hours, after the larger cobbles had been sorted out by hand. Raises were put up from the bedrock adit to work this gravel, which is said to have required little timber; it had to be drilled and blasted. The length of the adit is given in old reports as 7500 ft., but the distance from the mouth to the Mayflower line is claimed to be actually 1¾ mile. This bottom lead in the Paragon probably produced over one-half of all the mine's gold output.

The present company began preparations for hydraulic mining late in 1932, and a little gravel was washed in 1933. In 1934, after considerable work on the ditches, a substantial output, enough to make the mine the leading placer gold producer in the county for the year, was made. On May 29, 1935, about the end of the piping season, a serious bank slide occurred killing one man and completely covering the bedrock tunnel, monitors, much of the two 15-inch pipe lines, blacksmith shop and other equipment. When visited late in the summer, nothing had been done to reclaim the pit. The bank where the slide occurred is close to 400 ft. high, and the entire width of the channel as hydraulicked about 500 ft. The pay is principally in the lower 150 ft. (the distance between the bedrock and the upper Paragon lead) and of this, the best portion, judging from past hydraulic mining results, was in a thickness of 70 to 75 ft. which yielded 74 cents to 78 cents a cu. yd. Much drifting has been done since that hydraulicking (1879), and this would lower the average grade of remaining gravel decidedly. About one-half of the bank may be expected to prove barren, or nearly so, as it is composed of volcanic tuff and andesite. With an adequate water supply to permit six months piping, however, the mine might become an important producer. The Pond ditch, four miles long, is claimed to supply 600 miner's inches of water from Volcano Canyon; and Breece and Wheeler ditch from west branch of El Dorado Canyon is rated to yield 1000 miner's inches. The season for hydraulicking at this property was always short, but might be lengthened by fuller water development. When previously worked by this method, the average season's yield was apparently a little over $40,000.

Peckham Hill Gold Mines, Incorporated. The old Peckham Hill gravel mine is on the southwest end of the Forest Hill divide three miles southwest of Todds Valley, in the E½ of Secs. 7 and 18, T. 13 N., R. 10 E. The above company has been employing three or four men under contract during the past year or more, reopening an old adit.

An intervolcanic channel, believed by many to be the same one seen cutting the earlier gravels in several of the old mines from the Weske westward, occurs in this ground. It has at Peckham Hill a bedrock elevation of 2131 ft. in the Union tunnel in Sec. 17 near its outlet according to a survey by Ross E. Browne. In a length of one mile upstream from this tunnel several other attempts have been made without success to find pay gravel. About 1500 ft. upstream from the Union tunnel, Rough & Ready tunnel was run through the west rim 750 to 800 ft. and an incline was sunk down the bedrock rim for a length of 260 ft. reaching a bedrock elevation of 2143 ft. at its lowest point. There is no record of production from there. The same company (*Blue Gravel Range Company*) sank a shaft one-half mile farther upstream reaching a depth of 214 ft. where it is claimed a good prospect of gold was obtained. The operators are supposed to have been driven out of this shaft by water before reaching bedrock. This work was done about 1873 to 1875. In 1904, the Peckham Hill tunnel was run from Snyder Canyon toward the Blue Gravel shaft. According to George McAulay, then superintendent, a raise put up at a distance of 1800 ft. from the portal entered a body of gravel which proved to be 91 ft. long and 55 ft. wide and which paid well. This tunnel was continued to a length of 2400 ft. besides which several hundred feet of drifts were run above it in search of more gravel. No other deposit of pay gravel was found, and the main tunnel was not carried far enough to be under the shaft. The present operators estimated about 800 ft. or less would have to be run to make the connection. Work was progressing slowly with hand tools in the summer of 1935.

Penn Valley claim comprises the northern and eastern part of the original Strawberry Mine on the Succor Flat channel east of Indian Canyon in NW¼ Sec. 26, T. 15 N., R. 10 E.

In this claim the Succor Flat channel (which was worked upstream from the Indian Canyon side with a production of over $100,000 credited to the Strawberry) has been cut by two small later channels.

Macy Brothers are prospecting the ground through an adit, and in September, 1935, were raising at a point 1800 ft. from the portal.

Pond and Company Mine. The hydraulic mining camp of Todds Valley was a heavy producer, most of the work there having been done before 1875. By that time most of the mining ground in the camp had passed into the hands of Pond and Company and the principal part of the unworked gravel is now within the claim bearing their name, and containing 178.73 acres.

The deposit of quartz bench gravel at Todds Valley was worked in a northerly direction from the canyon front until the andesite overburden began to be too thick for hydraulicking. Whitney, writing before 1875, stated that the deposit one mile long by one-fourth mile wide with a maximum depth of 60 to 75 ft. and an average depth of 35 ft. had produced 9,000,000 cubic yards which had yielded $4,000,000 or 45 cents a cubic yard. He cited one measured area of 3.1728 acres on the Pond and Company claim, which yielded 35.88 cents per cubic yard for the entire bank, or 51.257 cents per cubic yard of gravel. Later figures of 11,000,000 cubic yards mined with a production of $5,000,000 in all from the district, have been published. The production recorded from Todds Valley after 1888 was usually $2,500 a year or less, representing the results of work of individuals engaged in small-scale mining.

There remains 2,000,000 to 4,000,000 cubic yards of gravel on the Pond and Company claim, but the possibility of working it is problemetical because of overburden which would interfere increasingly with hydraulicking beyond the present bank, and the average gold content, which is low for drift mining.

Ralston Divide Gravel Mine. The Ralston Divide lies between Long Canyon and Middle Fork of American River, and the property prospected by *California-Hawaiian Development Company* and its predecessors lies in townships 13 and 14 north, ranges 12 and 13 east. The above company once claimed about 9600 acres covering a length of 14 miles but only part of it was patented. The region is reached on the east by road past Soda Springs, and on the west by road and trail via Michigan Bluff or road via Georgetown and Barton's Cabin. The last company began prospecting in 1908, continuing until after 1920 and spent probably over $150,000 for equipment and prospecting. Previously, in the 1890's, a French company did considerable prospecting there.

The channel system underlying this ridge has its outlet at the Pat Goggins hydraulic mine (bedrock elevation 3475 ft.) in the SE¼ Sec. 22, T. 14 N., R. 13 E. The hydraulic pit here is 500 ft. long, 90 ft. wide and 60 ft. average depth. An adit was run 755 ft. from this pit with 750 ft. of branch drifts.

These deposits appear to be definitely connected downstream with the Bath channel and upstream with the gravel at Blacksmith Flat, Soda Springs and French Meadows. Hydraulic pits have been opened at several places in rim gravel on the north slope of Long Canyon, and some of these workings have been profitable. So far, however, no deposit has been found rich enough to pay for drifting on any important scale. The principal work of the California-Hawaiian Development Company was as follows:

No. 1 tunnel, with its portal in NE¼ Sec. 5, T. 13 N., R. 12 E. This is 7 by 8 ft. and was 4700 ft. long at the time of the last detailed report. About 2500 ft. of drifts, 1000 ft. of raises and 15 diamond drill holes were run from this tunnel.

No. 2 tunnel is over one mile south and a little west of No. 1 portal. It was 145 ft. long with an incline of 153 ft. and 280 ft. of drifting from the foot of the incline.

No. 3 tunnel was started near the center of NW¼ Sec. 8, T. 13 N., R. 12 E. and was run nearly northeast. It is 8 by 8 ft. in cross-section and over 1600 ft. long. It is connected by a raise of 14 ft. with the drift from the bottom of the incline sunk from No. 2 tunnel. A good deal of this later work was along the channel.

The prospecting of this area indicates the occurrence of wide stretches of flat river bed in which there has not been any important pay streak reported so far, rich enough to drift. The rim gravels or remnants of the earlier channel are interbedded with rhyolite tuff. A deeper blue lead is reported and this would correspond with the channel at Bath. To correlate these different runs of gravel with those in the Duncan Canyon region and northeastward to French Meadows, it is most reasonable to presume that the deep channel which crosses Duncan Canyon below the present drainage, upstream from the Glenn Mine is the later and deeper run; the deposits east of Duncan Canyon (Hard Climb, Red Star mines) are remnants or benches of the earlier channel, and the Glenn-Bald Mountain channel is not necessarily a tributary of the deep run. The accumulation of gravel and rhyolite beds on the Ralston Divide reaches a thickness of 250 ft.

Red Point (Golden River) Mine. In many respects, the story of the mining operations on the buried, ancient channel running through this property between Westville and Damascus is among the most interesting and instructive for this class of mines. Work started in July, 1886, and was carried on by a French company, *Société des Mines de Golden River,* until 1903, and then under the direction of the last superintendent, John A. Ferguson, by lessees until 1916. The adit was run 20,620 ft. and to within 1¼ miles in an air-line from Westville (Indian Springs). The gross production was 56,000 ounces of gold, and some dividends were paid.

This channel, belonging to the third intervolcanic period, flowed across the line of strike of schistosity of dikes and hard schist forming the bedrock. According to Ferguson it must have been an open, flowing stream when covered by andesite. The thickness of gravel varied usually from nothing to 6 ft. but averaged 1 ft. to 15 inches. As much as 2 to 3 ft. of bedrock was mined, and andesite formed probably one-half of the material washed. The gravel was in part tight, but not sufficiently so to require milling. The main adit was run 7 by 8 ft. in cross-section in bedrock with machine drills at a cost of $12.40 a ft. Raises 20 to 40 ft. long were put up to mine gravel. In mining, holes were drilled with moils in the andesite for blasting, and pieces of andesite over six inches were sorted. The grade of main adit at first was quite flat. In spite of irregularities in the elevation of bedrock, due to variations in hardness, which resulted in holes full of gravel in places, and bare bedrock in others, the average grade was uniform. Ferguson states that the channel raised 300 ft. in the distance mined, and that in one section of two miles he used a uniform grade of 19 inches in 100 ft. and found it correct. The width of channel varied from 12 ft. to 400 ft. Heavy timbering was required only where the gravel was thicker than the usual breasting height, or was so poor that it was left unmined. The average operating cost was $1.56 per one-ton carload and average yield, according to Ferguson, $2.25 a carload. These figures, for the average of the entire mine, vary considerably of course from results in certain sections. The low operating cost was due not only to efficient work but to the use of Chinese labor. These men were paid $1.75 a shift. White miners were paid $2.50 to $3.50 a shift. Fifty men mined and washed about 100 tons of gravel a day. In the later work a compressed air locomotive was used for hauling gravel trains. Water from the adit, supplemented by a supply from Humbug Canyon, was used for washing gravel. The natural flow from the workings was also used in four places where drop was available to drive water blasts for ventilation. A dry reheater for the air used in the locomotive is said to have increased its efficiency 40%.

Red Star Prospect. This is on the east side of Duncan Canyon one mile northeast of Jack Robinson tunnel and reached only by trails. Four adits at elevations ranging from 4500 to 4800 ft. were run years ago. Of these, the north adit on Hunted Hole Claim, gave the best idea of conditions. It branched 10 sets from the portal, one branch running north 130 ft. and the other northeast 145 ft. The prospect has not been visited by the writer for several years, and these adits may have been extended. High bedrock lay between the two and work had not been carried far enough to indicate with certainty whether this was a high reef in the channel, or if a junction existed. The gravel is well washed, carrying some quartz and large granite boulders. Although the average gold content had not been sufficiently high to pay steadily, rich places have been found from time to time, as in 1934 and 1935 when several ounces of coarse gold was produced.

The difference in elevation between this gravel and that west of Duncan Canyon, as indicated by aneroid, is so great as to indicate they are on different channels. A long ditch would be needed to bring water from Duncan Canyon.

Small Hope and Arthur Claim. Now part of the Detert Estate holdings (Mayflower group). On the northwest side of Forest Hill divide, two miles northwest of Forest Hill. The Small Hope and Sacramento claim adjoining it on the south were prospected through a series of adit driven south and east from First Brushy Canyon, and some hydraulicking had also been done. The production in early days is not recorded, but was only nominal after 1888. The channel is of intervolcanic cemented gravel.

In 1933 a permit to hydraulic the Small Hope and Arthur was granted to A. A. Hoffmann and H. A. Dart. No production was reported that year, but in 1934 Bert Farrar operated for a short time and made a nominal output.

Star United Mine. This old mine, fronting on Indian Canyon 1½ miles east of Iowa Hill was quite extensively mined in earlier days by hydraulicking and drifting and was credited with a production of $43,000 up to 1882. In later years Herman Gosch did considerable drift prospecting and made some production up to 1934. A section of the Succor Flat channel which crossed this claim was largely eroded away.

Brown Brothers and Good have had the property under lease during 1935, but report they have been able to do little mining on account of lack of water.

Succor Flat Channel entered the Iowa Hill district from the north but on the east side of Succor Flat Mine, in Sec. 26, T. 15 N., R. 10 E., it made a sharp bend to the northwest crossing that mine, the Schulbach and Strawberry. On the west side of the latter it was eroded by the present Indian Canyon but was followed and extensively worked on the west side of the canyon in the Stockton, Columbus, Shelby, Empire, Dayton, White Pine, Wolverine and Aurora Mines. From the Star United on, it is supposed to have followed close to the present course of Indian Canyon, which eroded it for nearly a mile and a half downstream to Iowa Hill, greatly enriching the modern stream. This channel received two tributaries, the Glencoe and Wolverine channels on the west side of Indian Canyon. An immense deposit of gravel was formed at their junction with the main stream on the Wolverine, Columbus, Dayton and White Pine Mines.

The Succor Flat channel carried loose gravel with a great deal of serpentine. The width worked varied from 50 ft. to several hundred feet. It had an average grade of about 180 ft. per mile, and was of pre-volcanic age. It has been worked for a length of about two miles, with the following approximate production records for the mines along its course. Most of this mining had been done before 1882:

Succor Flat Mine		$279,000
Strawberry (before 1882)		103,000
Strawberry & Penn Valley (1889–1897)		60,543
Stockton		41,000
Shelby		105,000
Columbus		100,000
Dayton	At junction of Succor Flat, Wolverine & Glencoe channels	156,000
White Pine	drift & hydraulic	756,000
Wolverine	drift & hydraulic	805,000
Star United		43,000
Phillips		80,000
		$2,528,543

Truro Placer Mine. On the North Fork of American River at the mouth of Pritchard Canyon. The gravel lies on an old river bench 150 ft. above the present stream. Many years ago, Truro Mining Company ran a crosscut adit 314 ft. through the rim 60 ft. below the bed of Pritchard Canyon and drifted on the gravel 75 ft. each way. Some breasting was done over a width of 46 ft., which yielded $1 a car. Nothing was done with the ground thereafter until the past year, when it was reported three men were working and that control of the old stock company was sold.

Weber claim in Iowa Hill district, is one of the holdings of the McGeachin company. About 1916–1917, *Stanislaus Development Company* had this claim under lease and drove an adit 1200 ft. long upon it, finding a barren intervolcanic channel 240 ft. above the bedrock of the Morning Star channel.

Whiskey Hill (Greek) Mine. This covered about 100 acres but included only 600 ft. in length on the channel of the same name, on the west side of Secret Canyon one mile south of Secret House. It was worked by a company of Greeks in the 1880's and is said to have yielded about $36 per running foot of channel, or $22,000 in all.

DREDGING

Marked activity in the prospecting and exploitation of shallow placer deposits in the Lincoln district has been evident in 1935. During the first half of the year, several pieces of leased land were being worked by different operators and five or six other properties were being prospected, with the probability that other plants would be in operation before the end of 1935.

The district mentioned is on the east side of Sacramento valley east and north of Lincoln. Geologically, it is situated along the Ione shore-line at its contact with granodiorite which is exposed here for a distance of nine miles eastward. The quartz mines of the Ophir district occur along the northeast contact of this granodiorite with amphibolite schist, and the contact region of the schist itself, along the strike northwest of Ophir, carries many gold-bearing deposits such as the old Whiskey Diggings. The gold in the present placers came from erosion of these veins. This gold is found partly in the old shore gravels which have been dissected by modern streams, and partly in the streams east of the shore-line. Although at one time an ancient river traversed the region four miles southeast of Lincoln, there are at present only streams which carry no water in the dry season. Water for mining is purchased from Nevada Irrigation District.

Due to the nature of the deposits and the portability of the equipment used near Lincoln, this type of placer mining is likely to be of a transitory nature. Some of the operations described hereunder have been terminated between the time of visit and the publication of these notes; notably those of Chittenden and Virginia Placer Company.

In the course of the work at some of these properties, attention was drawn to the large amount of quartz occurring in the gravel in partly rounded or slabby form characteristic of such creek gravel. Assays of some of this from the tailings gave high enough gold returns to induce further investigations with the idea of erecting plants for crushing the quartz. This work so far as known has not been carried far enough to prove the presence of any important tonnage of ore such as would be needed to justify erection of a good-sized milling plant.

Operation of two bucket dredgers has lately been started in the foothills east of Loomis, and drilling is at present going on along Antelope Ravine for a distance of about two miles between Loomis and Penryn, with the idea of moving in another small bucket dredger if results justify.

Antelope Creek Dredging Company. H. G. Peake and Thomas F. Nicholls, 311 California Street, San Francisco, took options late in 1935 for the purpose of prospecting, preliminary to the possible erection of a small bucket dredger, on ranch lands belonging to the following, along Antelope Ravine between Loomis and Penryn: Herbert N. Leake, E. H. Lardner, R. E. Naramore, G. E. Stoll, J. W. Robinson, Wm. Meade, Paul Pettit, J. A. Anderson, F. Willis, D. J. Gautier, H. C. Brainard, George Bock and Jean Monterichard. These holdings cover about two miles along the course of the ravine. The depth ranges from 7 to 22 ft.

If the results of prospecting are favorable, it is planned to bring in the machinery of a small dredge which has been operated lately on Canyon Creek in El Dorado County. This has 3-cu. ft. buckets and a capacity of about 50,000 cu. yds. a month. It was originally built to dig 18 ft. below water level, but while in use on Canyon Creek the digging ladder was lengthened to dig to 26 ft. It is planned to install long sluices for fine tailing, and drop coarser rock near the dredger, in order to leave the land level after dredging.

C. N. Chittenden Lease. This was on the Alfred G. Clark patented ranch land six miles north of Lincoln. It is on the Ione shore-line at an elevation of about 200 ft. The gravel is irregular and in patches, varying from 6 to 16 ft. in depth. It was dug with a one-half cu. yd. gasoline shovel and hauled in four auto trucks up a ramp, from which it passed through a trommel. The coarse gravel, mostly only a few inches in diameter, went to a rock bin for removal by trucks . The fines were sent over 300 sq. ft. of Hungarian riffles in sheet-steel boxes 2 ft. by 10 ft. set on a grade of about 10%. Fine tailing was pumped off by a sand pump. Six men working eight hours daily were reported to handle 350 to 400 cu. yd.

For washing, 20 miner's inches of water was purchased from Nevada Irrigation District. It was stored in a reservoir and pumped to the plant at the rate of 50 to 60 miners inches during the 8-hr. shift. Chittenden quit work here late in 1935.

Gold Hill Dredging Company, 601 Robert Dollar Building, San Francisco. Loomis No. 1 dredge has lately been put in commission on the S. C. Laird ranch, 2½ miles southeast of Loomis. The hull, which is 144 ft. long by 48 ft. wide, and draws 10 ft. of water was floated April 27, 1935. It is designed to dig 50 ft. It will work upon the Laird and O. L. Barton ranches.

Remnants of both early and late Tertiary gravel deposits left by the prehistoric American River were mined at the Haskell drift mine, seven miles northeast of these properties, but most of the gravel which no doubt once extended from there to the old Barton and Laird drift mines has been removed by erosion which has exposed the granodiorite over all the intervening distance. The course of the old stream is indicated by a series of small rounded hills, capped by andesite under which gravel has been mined in several places. On the Laird, Barton and Parmenter ranches, some 2½ miles in length of the ancient gravel is exposed, lying below the present drainage.

The *Laird Gravel Mine* was opened in 1850 and worked irregularly for many years. The total output of the claims consolidated under this name was said to be about $1,000,000 up to 1882. An hydraulic elevator was used, and some drifting was done, but the lack of grade was a hindrance.

Barton Drift Mine near the Laird was also a good producer for some time. It was opened through a 60-ft. shaft in 1892. The gravel was cemented, with cobbles seldom larger than fist-size. The channel was 350 ft. wide and was mined 6 to 7 ft. high. The gold was fine and flaky, and was high-grade, selling for $19 an ounce. A Cox pan was used for disintegrating the gravel.

On the *Parmenter* property (formerly *Anchor Mining Company*) similar cemented gravel has been found in shallow shafts, but so far has not been worked much.

This section of the old river was probably in the delta region where the stream entered the inland sea of Ione times. Some 25 years ago Samuel Laird installed an hydraulic elevator on his property near the Laird Mine and worked some shallow ground, but found the fluted granodiorite bedrock, where the pay lay in separate narrow channels, interfered seriously with this method of operation.

E. M. Kaufield, Oakland, is operating a drag-line dredging outfit two miles east of Lincoln. Two 160-acre pieces of land are reported under lease. The gravel here is 6 to 12 feet thick, lies on decomposed granodiorite bedrock and has a soil and sand overburden of 2 to 4 ft. which is stripped before mining. The gravel is reported to carry 50 cents gold per cu. yd.

Digging is done with a Link-Belt company drag-line having a boom 60 ft. long and a bucket of 1½-cu. yd. capacity. The washing plant is installed on a barge 30 by 40 ft. The revolving screen, 4½ by 28 ft., has a screen section 16 ft. long with three-eighths and five-sixteenths-inch holes, and a scrubber section with spirally-arranged baffles. The sluice area, 750 sq. ft., is larger than usual and tailing sluices on each side are 2½ ft. wide by 62 ft. long. The belt conveyor for stacking coarse tailing is 2 ft. wide and the stacker is 55 ft. long. One 6-in. and one 8-in. centrifugal pump are used, and power is furnished by a 60-h.p. Diesel engine. This plant is claimed to have a greater hourly capacity than others in the district. Eleven men are employed, in three shifts.

Lincoln Gold Dredging Company. Harry F. England, P. O. Box 3, Oroville; E. M. Clark and associates, of Oroville. This is one of the mobile drag-line dredge operations on shallow placer-mining ground four miles north of Lincoln. About 75 acres are believed to be covered with gravel 5 to 14 ft. deep, containing enough gold to be worked at a profit.

For digging gravel, a P. & H. drag-line on caterpillar mount is used. It has a boom 60 ft. long, uses a Diesel engine for power and has a 1¼-cu. yd. automatic Page bucket and is moved about on a heavy timber mat when on soft ground. The washing equipment is mounted on a wooden barge 26 by 30 ft. in area. This carries a grizzly with 13-inch spaces, on which the load is dumped; revolving screen, 4 by 25 ft.; seven sets of sluices 10 ft. long, giving about 160 sq. ft. of sluice, with Hungarian riffles, as well as a tailing sluice 4 by 45 ft. on each side, and a rubber belt stacker 2 ft. wide and 45 ft. long. A 7-inch centrifugal pump raises water for washing and a 60-h.p. Diesel engine furnishes power.

This deposit is along the old Ione shore-line and has a soft volcanic-ash bedrock which permits easy digging, taking 1 to 2 ft. of bedrock. The pay gravel is reported 500 ft. wide and is said to yield about 24 cents a cu. yd. The plant handles about 100 cu. yd. an hour and runs about 18 hours out of 24.

Oakwood Placer Mining Company. H. O. Comstock, president. This company is working on a part of the Oakwood stock ranch in Secs. 15, 22, 23, 24 and 25, T. 13 N., R. 6. E., six miles north of Lincoln. The property lies at the extreme western exposures of the bedrock formations, near and on the old Ione shore-line, and within a mile of the floor of Sacramento Valley. The surface is crossed by branches of Coon Creek and Doty Ravine and mining started upon one of these on April 1, 1935. The gravel is reported 6 to 18 ft. deep and has a shallow soil capping.

The plant consists of a No. 700 P. & H. dragline on caterpillar treads, using a $1\frac{1}{2}$-cu. yd. bucket and with a 150-h.p. Diesel engine and 50-ft. boom. The barge carrying the other machinery has a hull 30 ft. by 40 ft. and the equipment is housed in with galvanized iron. Electric power (a total of 115 h.p.) is used to operate a standard dredge trommel and belt conveyor stacker, and the 5-inch and 6-inch pumps which deliver 1300 and 1800 g.p.m. of water respectively. The latter supplies water for the trommel, through nine $1\frac{1}{2}$-in. nozzles and 65 $\frac{3}{8}$-in. jets. On each side of the barge, riffles are carried in five boxes 14 ft. long by 27 in. wide and in a tailing sluice 40 ft. long. There is also a nugget sluice 12 in. wide.

With 10 men besides the superintendent, H. B. Eden, it is claimed 1500 cu. yd. of gravel is washed daily. Fifty gallons of Diesel oil and $1 worth of lubricating oil is used daily by the engine operating the dragline.

Oro Bell Dredging Company. Earl E. Chenoweth, manager. Sec. 2, T. 10, N., R. 7 E., and adjacent land in Allen district, six miles east of Roseville. About 900 acres reported under lease.

This company began work June 1, 1934, with a second-hand bucket dredger carrying 76 buckets of four cu. ft. capacity each. Originally the depth capacity was 20 ft. but this was to be increased to 31 ft. The hull is 42 by 91 ft. About 280 h.p. of electric energy is used and the capacity is about 2500 cu. yd. a day. The ground is loose, sandy creek gravel lying on soft decomposed granodiorite bedrock. The large proportion of sand has caused a problem, and in April, 1935, two sand wheels $14\frac{1}{2}$ ft. in diameter were being installed to dispose of it. The average depth of digging up to that time had been 10 to 15 ft.

Skeels, E. B., and Pantle Brothers are operating a placer mining outfit on Miners Ravine in Allen's district, just upstream from the Oro Bell dredger. The ground varies from 8 to 28 ft. deep, and consists principally of sandy loam and sand, with only a little small creek gravel, on fluted granodiorite bedrock.

A. P. & H. model 600 drag-line with a bucket of 1 cu. yd. capacity, on a 60-ft. boom delivers material to the washing plant. Both are mounted on caterpillar treads. The washing plant has a capacity of 32 cubic yards an hour of fines after screening. Material is screened through a trommel with double screens the smallest with one-fourth inch holes. Fines through the screens pass to four Ainlay centrifugal concentrators. Tailing from these is pumped into worked-out pits and the small amount of gravel (10% of total mined) after washing in the trommel is stacked by a belt conveyor 40 ft. long. Water for operation is pumped from the creek through a hose line.

The gold is reported to be mostly on and within 3 ft. of bedrock. The bedrock has to be cleaned by hand shoveling on account of its fluted character.

Virginia Placer Company (not incorporated). T. E. Robinson and H. S. Tharp. Operating on the Nissen or Schuler Ranch, six miles northeast of Lincoln, of which 60 acres has been leased for mining.

A. P. & H. dragline outfit is used for digging shallow gravel, which probably consists of remnants of Ione shore-line gravels, dissected by later streams and gullies. The gravel lies under 2 to 3 ft. of soil and sand and the average depth of digging has been 10 to 11 ft. In places a depth of 18 ft. is reported. This is about the limit for this type of plant. The bedrock is decomposed granite, yielding abundant sand, and it is estimated that 70% of material dug passes through the sluices. As usual in such cases of gravels on or near an old shore-line, the 'channels,' as the operators call them, are hard to follow. They are likely to be the fillings of saucer-like depressions which in cross-section would have the aspect of channel segments. Any channel segments remaining would be remnants of a former course of a branch of Coon Creek, which runs almost in the line of strike of some of the Ophir quartz veins.

The dragline outfit is on a caterpillar mount and has a 60-ft. boom. Power is furnished by a 120-h.p. gasoline engine. The bucket has a capacity of $1\frac{3}{4}$ cu. yds. and has had many changes made in it to improve digging and durability of wearing parts. The barge carrying the washing plant has a hull 30 ft. by 40 ft. which carries two 47-h.p. Caterpillar Diesel engines, one 8-in. and one 6-in. pump, trommel, belt conveyor stacker, and over 200 linear feet of Hungarian riffles. Eleven men are employed, running the washing plant 16 hours and dragline 18 hours, and handling 1200 cu. yd. daily at a reported cost of 15 cents to 25 cents a cubic yard. Sixty miner's inches of water is purchased from Nevada Irrigation District.

TABLE OF PLACER MINES AND PROSPECTS, PLACER COUNTY

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Acacia	14	15 N.	11 E.	George McAulay, Auburn		R. XV, p. 379
Alabama				Estate of P. D. Winter, 530 22d Ave., San Francisco		
Allbright	36	12 N.	7 E.			R. XII, p. 204; XIII, p. 272; XV, p. 352
Alta	36	16 N.	10 E.	Alta Gold Mining Co., 1118 Broadway, Oakland	6	R. XII, p. 204; XIII, p. 272; XV, p. 352
American	34	16 N.	10 E.	George V. Nicholls, et al., 2647 24th St. San Francisco	31	
American Hill	24	15 N.	12 E.	Pendleton Brothers		XV, p. 352; XXXI, p. 19
American River Gold Mng. Co.	23	13 N.	9 E.	American River Gold Mng. Co., c/o I. P. Barnett, 111 Sutter St., San Francisco	480	R. XXXI, p. 19
Anglo American	27, 34	15 N.	10 E.	Hazel McIntosh Kuhlman, 205 Washington St., Roseville; Alice Goding, 518 N. Ophir St., Stockton; Gilmore Airship Co., Nevada City, et al.	37	
Argonaut & Sunset	22	14 N.	11 E.	C. E. Burns, Auburn		
Armbruster	33	14 N.	10 E.	J. M. Gilbert, Paris, Missouri		
Attulas	26	15 N.	10 E.	Attulas Mng. Co., c/o W. S. Macy, Iowa Hill		
Avalon	2	15 N.	13 E.			R. XIII, p. 273; XV, p. 352; abandoned
Azalea	22	16 N.	11 E.	Blue Canyon Mng. & Dev. Co., 1821 E St., Sacramento, c/o Mrs. W. J. Holmes	360	R. XIII, p. 275; XV, p. 352
Bake Oven				S. S. Caples, 3634 6th Ave., Sacramento		
Baker Divide	12, 13, 18	14 N.	10 E.	Baker Divide Mining Co., c/o W. A. Richardson, Russ Bldg., San Francisco		R. VIII, p. 466; IX, p. 29; XIII, p. 273; XV, p. 352; XXXI, p. 19
Baker Ranch	17	14 N.	11 E.	F. B. Ellsworth, Baker Ranch		R. XV, p. 353
Bald Mountain	21, 22, 28	15 N.	13 E.	A. Borchard, 2415 I St., Sacramento	160	R. X, p. 426; XIII, p. 273; XV, p. 353; XXI, pp. 276-77
Baltimore						See Mascot
Banner	34	16 N.	10 E.	W. H. Rablin, c/o Wm. Rablin, 1405 J. St. Sacramento		R. XV, p. 353
Bartley Cons.	26	16 N.	10 E.	Estate of Wm. Rablin, 1405 J St., Sacramento, et al.	110	R. XV, p. 353
Bear River	4	15 N.	10 E.	W. H. Rablin, c/o Wm. Rablin, 1405 J St., Sacramento		R. XV, p. 379
Bear River	12, 13 14, 23	15 N. 15 N.	9 E. 9 E.	Bear River Gold Mng. Co., 401 J St., Sacramento		
Bear River Ext.	14	15 N.	9 E.	E. C. Uren, Nevada City		R. XV, p. 379
Bear River, Texas Hill Ext.	34 21	16 N. 16 N.	10 E. 12 E.	Grace A. Gould, Fremont Ave., Mountain View		
Bear River Hill, Queen City, et al.	34	16 N.	10 E.	George V. Nicholls, 2647 24th St., San Francisco	135	
Bear River Tunnel	12	15 N.	9 E.	Mrs. Chas. Voight, 1128 10th St., Oakland, Cal., & Wm. Nicholls, Jr., 846 Mendocino Ave., Berkeley		

Bear River Tunnel	6 5, 6, 7	15 N. 15 N.	9 E. 10 E.	W. H. Rablin, c/o Wm. Rablin, 1405 J St., Sacramento		R. XV, pp. 379-380
Belle Verne	26, 35	15 N.	12 E.	George H. Smith, Last Chance	80	R. XV, p. 353
Belvit and American Eagle				Mrs. L. Bellows, Dutch Flat		
Ben Franklin	27	14 N.	10 E.	Joe Gilbert & R. C. Burry, Foresthill	160	R. XII, p. 205; XIII, p. 274; XV, p. 353
Big Bar	20	14 N.	13 E.			R. XV, p. 353
Big Chief				F. W. Tillotson, Michigan Bluff		R. XXXI, p. 20
Big Dipper, et al.	3, 4	14 N.	10 E.	McGeachin Placer Gold Co., Capital National Bank Bldg., c/o C. H. Dunn, Sacramento	162	R. VIII, p. 472 X, p. 423; XII, p. 205; XIII, p. 274; XV, p. 374; XVII, p. 447; XXIII, p. 264; Bull. 92, pp. 135-136
Big Gold Bar	16	14 N.	13 E.	Jas. Colvin, Michigan Bluff, et al.		
Big Gun, Thompson & Powell	22	14 N.	11 E.	W. S. Willey, Michigan Bluff		R. XV, p. 354; XIII, p. 285
Biglo				Estate of James Abrams, c/o A. Dixon, 2322 W St., Sacramento		
Big Spring				Edw. W. Drone, McKeon, et al.	117	
Birds Flat	22	15 N.	10 E.	Henry Del Rey, Iowa Hill		
Black & Brown, et al.	13, 14 23, 24	14 N. 14 N.	10 E. 10 E.	Chas. H. Freeman, 206 Foxcroft Bldg., San Francisco, et al.	603	
Black Hawk	13, 14	14 N.	10 E.	W. A. Freeman Estate, T. A. Nichols, Mgr., 206 Foxcroft Bldg., San Francisco	639	R. XIII, p. 274; XV, p. 354
Blue Canyon						See Azalea
Blue Channel	22	15 N.	10 E.	Blue Channel Mining Company	465	
Blue Eyes Prospect	32 5, 7, 8 17	15 N. 14 N. 14 N.	13 E. 13 E. 13 E.	S. S. Caples, et al., 3634 6th Ave., Sacramento	2,550	R. XV, p. 354; XVII, pp. 447-48; XVIII, pp. 211, 603; XIX p. 141; Pre. Rep. 8, pp. 33-34; XX, pp. 13-14; XXI, p. 277; XXIII, p. 264
Bob Lewis	14, 23	15 N.	11 E.	I. L. Pierce, Foresthill	320	R. XIII, p. 275
Bob Lewis	33, 34	15 N.	12 E.	J. F. Thompson, Foresthill	44	
Bogus Thunder	19	14 N.	13 E.	S. S. Caples, 3634 6th Ave., Sacramento	250	R. XV, pp. 354, 380
Boles	34	12 N.	8 E.	W. Fitch, E. L. Rene, Auburn, et al.	100	R. XXIII, pp. 264-265
Booth River	29	15 N.	10 E.	Booth River Mng. Co., c/o E. E. Booth, Colfax		R. XV, p. 380
Bouck						R. XXXI, p. 17
Bowen	10	14 N.	11 E.	Mrs. F. A. Bowen, 601 54th St., Oakland, Cal.		R. XIII, p. 275; XV, p. 354
Bradley & Gardner				Estate of Wm. Rablin, 1405 J St., Sacramento, et al.		
Breece & Wheeler						See Paragon
Brooklyn & Olympia	26, 35 36	15 N. 15 N.	12 E. 12 E.	Messrs. Threlkeld and Blohm, San Francisco	235	R. XV, p. 354
Buchanan	32, 33	14 N.	10 E.	Mary Z. O'Connor, 3025 Deakon St., Berkeley; Mrs. J. F. Ryerson, 303 Magnolia Ave., Piedmont		
Buckeye Bar	33, 34	13 N.	9 E.	Shock, Philadelphia		
Bull Run, North Fork and Bear River	35	16 N.	10 E.	Wm. Nicholls, Jr., 846 Mendocino Ave., Berkeley, et al.		
Bumpus Canyon, Pete Just Canyon	4, 5, 6, 7 33	14 N. 15 N.	10 E. 10 E.	Indian Canyon Gold Company, Ltd., 532 Grant Ave., San Francisco	150	
Burns	22	14 N.	11 E.	Michigan Bluff Mexican Cons. Mng. Co., Wm. Burns, Sec., Placer County Bank, East Auburn	200	R. XIII, p. 276; XV, p. 354

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* To save space, frequently only one of several names is shown in this column.

TABLE OF PLACER MINES AND PROSPECTS, PLACER COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Calif. Chief Development Co.	1 5, 6 30, 31	13 N. 13 N. 14 N.	9 E. 10 E. 10 E.	Calif. Chief Development Co., 608 Dooly Bldg., Salt Lake City, Utah	816	
Calif.-Hawaiian Dev. Co.		13 N. et	12 E. al.	Calif.-Hawaiian Dev. Co., 858 Mills Bldg., San Francisco		See Ralston Divide Gravel
Calif. & Virginia	32 5, 6	14 N. 13 N.	11 E. 11 E.	Duffey and Stevens	150	
Cambridge	9, 16 17, 19 20	14 N. 14 N. 14 N.	10 E. 10 E. 10 E.	Mrs. Stemple, Colfax		R. XV, p. 380
Canada Hill	4, 5, 9	15 N.	13 E.	Henry Snyder, E. Armstrong, et al., Grass Valley	310	R. XV, p. 354
Canothos	23	14 N.	10 E.	Estate of James Gavin, Forest Hill	46	Field Report
Canyon Creek	1	15 N.	10 E.	George B. Downning, et al., 531 N. New Ave., Monterey Park, Los Angeles	57	
Canyon Creek	10	15 N.	10 E.	Stewart Gravel Mines, c/o J. D. Stewart, 138 Commercial St., Auburn	10	R. XIII, p. 276; XV, p. 380
Carey	27	15 N.	10 E.	E. S. Benham & Wm. A. Pelster, Iowa Hill	120	R. XV, p. 354
Carmack	4, 5	15 N.	13 E.	Mrs. Marguerite Carmack, 1522 E. Jefferson St., Seattle, Washington	130	R. XV, pp. 368-69; XVII, pp. 448-49; XVIII, pp. 263, 603; Pre. Rep. 8, p. 34; XXIII, p. 265
Cedar Creek	3	15 N.	10 E.	J. L. Gould, Alameda	460	R. XII, p. 206; XIII, p. 276; XV, p. 355
Cedar M.				Martha Thomas, Towle, & John Thomas		
Collins	31	15 N.	10 E.	W. B. Fowler, Colfax		R. XV, p. 380
Consolidated Junction	26, 27 34, 35	16 N. 16 N.	10 E. 10 E.	George V. Nicholls, et al., 2647 24th St., San Francisco	70	
Comet				Joseph J. Cavanaugh, P. O. Box 356, Bouse, Yuma County, Arizona		
Comet, et al.	3, 4	15 N.	10 E.	Gold Run Ditch & Mng. Co., Cisco Grove Auto Camp and Service Station, Cisco	126	R. XII, p. 209; XIII, p. 279
Copper Bottom	25	15 N.	10 E.	M. E. & S. E. Sweet, 821 W. 5th St., San Jose	58	R. XV, p. 355; XVIII, p. 211
Dam	26	15 N.	11 E.	Hidden Treasure Gravel Mng. Co., Harold T. Power, Sec., 1407 Kenneth Road, Glendale, et al.	85	R. XV, p. 355
Damascus	23, 26	15 N.	11 E.	I. L. Pierce, Foresthill	175	R. VIII, p. 469; IX, p. 29; 120; X, p. 451; XII, p. 209; XIII, pp. 277, 281; XV, p. 355
Dardanelles	2	13 N.	10 E.	T. L. Chamberlain, Auburn	312	R. VIII, p. 464; IX, p. 29; X, p. 465; XII, p. 207; XIII, p. 277; XV, p. 355; Bull. 92, p. 136
Dayton	27	15 N.	10 E.	M. E. Poor, Iowa Hill	10	
Delmus Group	26, 35	16 N.	10 E.	Mrs. Irma Delmus, Box 722, Alta	110	
Derby	26, 35	15 N.	11 E.	A. F. McCollam, Yankee Jims	140	
Derby & Wild Cat	11, 12	13 N.	9 E.	J. A. Ware, McKeon	46	

Devil's Basin	1 25	14 N. 14 N.	11 E. 10 E.	R. Lofruth, Deadwood; J. E. Ferguson, Michigan Bluff. Under option to Double-O Mining Company		R. XIII, p. 282; XV, p. 355
Devil's Gate				Charles Pinoli, Foresthill		R. XV, p. 356
Dewey Cons.	33, 34	15 N.	10 E.		137	R. XV, pp. 356-57
Dixie Queen	9, 16 17	14 N. 14 N.	13 E. 13 E.	L. A. Davidson, Foresthill	240	R. XV, p. 357; Pre. Rep. 8, p. 34; XXI, pp. 277-278; XXXI, p. 21
Dorr	33 3, 4	14 N. 13 N.	10 E. 10 F.	Mary Stevens, et al., 2527 Fillmore St., San Francisco	80	
Double-O Mng. Co.	31, 32	15 N.	12 E.	Double-O Mng. Co., c/o C. McCarthy, Michigan Bluff	414	R. XXXI, p. 265; Pre. Rep. 8, p. 34
Dow	33	14 N.	10 E.	Mary Dow Stevens, 555 Bush St., San Francisco, et al.		
Dragon and Carr	1	15 N.	10 E.	Estate of Mrs. George Opel, c/o J. W. Jamison, Towle		
Dutch Flat Blue Lead	3	15 N.	10 E.	C. S. Jordan, Dutch Flat, and J. L. Gould, 16 Ensloe Ave., Alameda	80	R. XV, p. 357
Dutch Flat Canyon	34	16 N.	10 E.	Mrs. H. L. Beal, 123 Terminal St., San Jose, et al.		
Dyer	35	16 N.	10 E.	Lewis A. Gould, Fremont Ave., Mountain View	20	R. XV, p. 357
Eagle Bar				William Duffy, Foresthill		R. XV, p. 357
Elite	31, 32	16 N.	11 E.	R. Monroe, et al., Dutch Flat	425	R. XIII, p. 278; XV, p. 357
Empire	22, 27	15 N.	10 E.	Frank Schmetzer, Edgerton, Ohio	20	
Empire & Humbug Flat	3	15 N.	11 E.		60	
Empire No. 2	3	15 N.	11 E.	Leopold Richard Dorer, Auburn		
Enterprise Leasing Co.				F. G. Fabian, et al.		R. XXXI, p. 19
Erie	25	15 N.	9 E.	Erie Mng. Co., c/o J. W. Morgan's Estate, Auburn		
Estey						See Rocky Bar
Eureka Cons. Drift Mining Company	8, 9 10, 17 19	15 N. 15 N. 15 N.	12 E. 12 E. 12 E.	Eureka Cons. Drift Mng. Co., Rooms 2012-2014 Hunter-Dulin Bldg., San Francisco	2,091	R. XIII, p. 278; XV, p. 357
Excelsior	33	15 N.	10 E.	Mrs. P. L. Yardley, Hotel Senator, Sacramento, et al.	24	
Excelsior						See Mascot
Federal	34	16 N.	10 E.	Federal Drift Mng. Co., W. T. Watson, Supt., Dutch Flat; Dr. W. B. Coffey, Pres.	125	R. XV, p. 358
Fernier	16, 18	13 N.	10 E.	R. R. Read, 812 Broadway, Oakland	240	
Fitzpatrick	32	15 N.	10 E.	M. E. Poor, Iowa Hill		R. XV, p. 359
Florida & Tilton	25	14 N.	10 E.	A. Jones, 1615 15th Ave., Seattle, Washington	109	R. XV, p. 359
Flying Fish	34	16 N.	10 E.	John C. and Ed. Uren, 1016 N St., Sacramento	15	R. XV, p. 359
Forest Hill Mng. Corp.	15, 16 et al	14 N.	11 E.	Forest Hill Mng. Corp., Box 734, c/o Paul Staples, Oxnard	928	
Foss						See Maguire
Frank Hoffman	28, 29 33	14 N. 14 N.	11 E. 11 E.	A. F. Kavanaugh, Michigan	161	
Franklin	10	14 N.	11 E.	Geo. V. Nicholls, 2647 24th St., San Francisco		R. XIII, p. 278; XV, p. 359
Franklin House						R. XXXI, p. 20
General Grant	27, 33 34	15 N. 15 N.	10 E. 10 E.	D. L. Sprague & M. E. Watts, 1317 24th St., Sacramento, Iowa Hill Gold Mng. Co., Iowa Hill	90	R. XXXI, p. 20
Georgia Cons.	9, 10	14 N.	11 F.	D. M. Burns, et al., 614 Crocker Bldg., San Francisco.		

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TABLE OF PLACER MINES AND PROSPECTS, PLACER COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Georgia Hill Gravel Mng. Co., Inc.	33	14 N.	10 E.	A. C. Bequette, Auburn	757	R. XVIII, p. 211; Pre. Rep. 8, p. 34; XXIII, p. 266
Gillespie	33	14 N.	10 E.	Lilla M. Rossi, 646 Vernon St., Oakland, et al.	33	
Gillett	31	15 N.	10 E.	F. N. Gillett, Colfax		R. XV, p. 380
Gleason	9, 10	14 N.	10 E.	Mrs. M. Gleason, Iowa Hill		R. XV, p. 359
Glenn Cons.	22, 27 28, 34	15 N. 15 N.	13 E. 13 E.	J. M. Inman, Downieville	660	R. XIII, p. 278; XV, pp. 359-360; XVII, p. 449; XVIII, pp. 7, 603; Pre. Rep. 8, pp. 34-35; XX, p. 13; XXI, p. 278; XXIII, p. 266; Bull. 92, p. 140
Golden Channel	1	16 N.	11 E.	J. W. Hyatt, Emigrant Gap	480	R. XV, p. 360
Golden Dipper				Golden Dipper Placer Mng. Co., 232 Fairgreen Ave., Youngstown, Ohio		
Gold Dollar						See Blue Eyes
Golden Gate	22	15 N.	13 E.	L. & A. Borchart, 2415 I St., Sacramento		See Bald Mountain
Golden Gate No. 2	28	15 N.	13 E.	A. L., Alfred, Mabel, Karl, Dorothy and Marie Borchart, 2415 I St., Sacramento		
Golden Gem, et al.	15, 16	14 N.	11 E.	A. K. Robinson, Auburn	193	
Golden Nugget	12	16 N.	11 E.	C. M. Everhart, Gold Run	640	R. XV, p. 360
Golden River	11, 12 13, 14 23	15 N. 15 N. 15 N.	11 E. 11 E. 11 E.	Red Point Mining Co., c/o J. A. Ferguson, Foresthill	600	R. VIII, pp. 470-472; IX, p. 29; X, p. 456; XII, p. 208; XIII, p. 279; XV, p. 360
Golden Rule	5	15 N.	11 E.	George J. Morill, c/o W. E. Dean, 106-111 Federal Realty Bldg., Oakland	39	
Golden Shaft	35	16 N.	10 E.		9	R. XIII, p. 279
Golden Star	24	15 N.	10 E.	Golden Star Mng. Co., c/o N. E. Booth, Colfax	140	R. XV, p. 360
Golden Streak	35	15 N.	10 E.	Golden Streak Cons. Mng. Co., Colfax, c/o F. D. Kuensley	130	R. XV, p. 360
Golden West	4	15 N.	13 E.	Golden West Cons. Mng. Co., c/o E. H. Armstrong, 208½ W. Main St., Grass Valley	400	R. XV, p. 361
Gold Hill Dredging Co.				Gold Hill Dredging Co., 601 Robt. Dollar Bldg., San Francisco		R. XXXI, pp. 19-20
Gold Ring	1	15 N.	10 E.	W. N. West, c/o C. N. Taylor, & Dr. W. M. Tryon, 409 Pacific Bldg., San Francisco	63	R. XIII, p. 279; XV, p. 360
Gorman	21, 28 29	14 N. 14 N.	11 E. 11 E.	A. A. Gorman, Michigan Bluff	400	R. XV, p. 361
Gould	23	15 N.	10 E.	Gould Placer Mng. Co., c/o D. S. Steanberger, San Diego		Field Report
Gould Group	26, 33 34 3, 4	16 N. 16 N. 15 N.	10 E. 10 E. 10 E.	J. L. Gould, 1450 Middlefield Road, Palo Alto	133	
Great Channel						See Hermit
Greek	1	15 N.	12 E.	Martin, Burner, et al., Forest Hill		R. XVII, p. 449; Pre. Rep. 8, p. 35

Green Valley Blue Gravel	6	15 N.	11 E.	Estate of Vivia Hemphill & S. F. Theological Seminary, 228 McAllister St., San Francisco	56	
Grey Eagle	6	13 N.	10 E.	Calif. Chief Development Co., 608 Dooly Bldg., Salt Lake City, Utah	146	R. XIII, p. 279-280; XV, p. 361; XXIII, p. 267
Grizzly Canyon and Weber & Co.	3, 10	14 N.	10 E.	Estate of Chauncey H. Dunn, 317 Capital National Bank Bldg., Sacramento	176	
Haney Cons.	4 33	14 N. 15 N.	13 E. 13 E.	Thomas F. Haney, Last Chance	--------	R. XV, pp. 380-381
Hard Climb	3, 9	14 N.	13 E.	Estate of McCullough, Michigan Bar and Charles Hilton, c/o Glen Mine, Last Chance	400	R. XV, pp. 361-62; Pre. Rep. 8, p. 35; XXI, pp. 278-79
Harmon	--------	--------	--------	--------	--------	See Big Dipper
Haskell	21, 28	12 N.	8 E.	Haskell Gold Mining Co., c/o Ed. Gaylord, Auburn, et al.	180	Field Report
Hassler	28	12 N.	8 E.	--------	--------	R. XV, p. 362. See Haskell
Haub	28	16 N.	11 E.	Robert Watson, Blue Canyon	33	R. XIII, p. 280; XV, p. 362
Hayden Hill	6	15 N.	11 E.	James Ross, Towle		
Hazard	16, 21	14 N.	11 E.	Hazard Gravel Mng. Co., c/o W. S. Andrews, Newhall Bldg., San Francisco	222	
Hector Ranch	--------	--------	--------	--------	--------	R. XXXI, p. 20
Hermit	3	14 N.	11 E.	Mrs. Bowen, Michigan Bluff	--------	R. XIII, p. 280; XV, p. 362
Hidden Treasure	26, 27 34, 35	15 N. 15 N.	11 E. 11 E.	Hidden Treasure Gravel Mng. Co., Harold T. Power, Sec., 1407 Kenneth Road, Glendale	85	R. VIII, p. 469; IX, pp. 29, 120; X, p. 451; XII, pp. 209-210; XIII, p. 281; XV, p. 362; U.S.G.S. Paper 73
Hogsback Cons.	1, 2, 3	15 N.	12 E.	Hogsback Cons. Pl. Mng. Co., c/o J. A. Ferguson, Foresthill	298	R. VIII, p. 472; XIII, p. 281; XV, p. 363
Homestake	31	14 N.	11 E.	M. Savage, Foresthill	--------	R. XV, p. 363
Home Ticket	26, 35	15 N.	12 E.	J. F. Thompson, Foresthill	--------	R. XV, p. 363; Pre. Rep. 8, p. 35; XVIII, p. 211; XXXI, p. 20
Hoose, Garden Claim, You Bet and Brown	33, 34	16 N.	10 E.	George V. Nicholls, et al., 2647 24th St., San Francisco		
Horseshoe Bar	4	13 N.	11 E.	Horseshoe Bar Cons. Mng. Co.	62	R. IX, p. 277; XIII, p. 281; XV, p. 382
Hosmer	6	13 N.	10 E.	C. H. Freeman, et al., c/o Tom Nicholls, 206 Foxcroft Bldg., San Francisco	59	
Indian Canyon	27, 28 33	15 N. 15 N.	10 E. 10 E.	Margaret G. Barrett, 222 2d Ave., San Francisco; C. E. Tegler, 625 S. 2d St., San Jose, et al.	59	
Indiana Hill	9, 10	15 N.	10 E.	J. L. Sparbawk, Iowa Hill	--------	R. XV, p. 363
Iowa Hill	26, 27	14 N.	10 E.	Wm. Muir, Oakland		
Iowa Hill and Byrds Flat	34	15 N.	10 E.	Jas. J. Cavanaugh, P.O. Box 356, Bouse, Yuma County, Arizona; Mary Gleason Cross, B. Marsh & Eliza Gleason Sullivan, 622 15th Ave., San Francisco		
Irish & Byrne	3, 4	14 N.	10 E.	McGeachin Placer Gold Mng. Co., 317 Capital National Bank Bldg., Sacramento, c/o C. H. Dunn		
Italian	--------	--------	--------	C. D. McKinley, Auburn		

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* To save space, frequently only one of several names is shown in this column.

TABLE OF PLACER MINES AND PROSPECTS, PLACER COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Jack Robinson	16	14. N	13 E.	S. S. Caples, 3634 6th Ave., Sacramento		R. XV, p. 363
Jarvis	14, 15	15 N.	11 E.	H. M. Jarvis, Mobile, Alabama	160	R. XV, p. 363
Jefferies, Live Oak	27	15 N.	10 E.	F. M. Howard, et al., 3720 1st Ave., Sacramento	36	
Jupiter Cons.	11	14 N.	10 E.	McGeachin Placer Gold Mng. Co., 317 Capital National Bank Bldg., c/o C. H. Dunn, Sec., Sacramento	250	R. XV, p. 363
Kelly	9	11 N.	8 E.	M. A. Kelly, Auburn		R. XV, p. 382; XXXI, p. 20
Kinder River	28	15 N.	10 E.	Estate of T. L. Schwab, Iowa Hill		R. XV, p. 382
Ladies Canyon				W. F. Ford, Forest Hill, c/o George S. Ford		
Laird River Claim				Sam Laird, Loomis		R. XIX, pp. 140-141; XXIII, p. 267
Lebanon	3	14 N.	10 E.	Lebanon Mng. Co., c/o M. Frentel, 404 28th St., Oakland; J. E. Walsh, Auburn; C. H. Freeman, 206 Foxcroft Bldg., San Francisco, et al.	130	Field Report
Lehigh	30	14 N.	11 E.	J. F. Thompson, Foresthill		R. XV, p. 382
Bob Lewis						See Jarvis
Live Oak	22	14 N.	10 E.			R. VIII, pp. 474-75; IX, p. 29; XIII, p. 282
Lofruth						R. XIII, p. 282; See Devil's Basin
Lost Camp	23	16 N.	11 E.	E. T. Robie, Auburn; Geo. F. Miller, Blue Canyon, et al.	600	R. XIII, p. 282; XV, pp. 364, 376-77; XVII, p. 451; XXXI, p. 20
Lucky George	16	14 N.	13 E.	M. Savage, 1242 Polk St., San Francisco	40	
Macedon	1	15 N.	12 E.	Katherine J. Hall, 2411 Hillside Ave., Berkeley; Mrs. Agnes Snyder, Foresthill; Tellulah E. Richards, Box 344, Sausalito	110	R. XV, p. 364; XVII, p. 449; Pre. Rep. 8, p. 35
Mad Canyon, New York Bar, Apache				Marsh Lowell, Auburn		
Maguire				Mr. and Mrs. Wm. Maguire, Nevada City		R. XV, p. 364
Mammoth	30	16 N.	12 E.	J. P. Molter, 2306 L St., Sacramento	122	
Mammoth Bar	5, 6 32, 33 34	12 N. 13 N. 13 N.	9 E. 9 E. 9 E.	Howard W. Davis, Auburn, et al.	132	R. IX, p. 280; X, p. 417; XII, p. 210; XIII, p. 282
Manhattan	15, 16	14 N.	11 E.	Estate of A. K. Robinson, Auburn	157	
Marian	35	14 N.	11 E.	Estate of E. A. Hill, Michigan Bluff	185	R. XV, p. 364
Martin	31	15 N.	10 E.	F. P. Gallaher, Colfax	20	R. XV, p. 382
Mascot	26	14 N.	10 E.	George McAulay, Auburn, et al.		R. XV, pp. 357-358; XVII, pp. 449-450; XIX, p. 13; XXIII, pp. 265-66
Masonic	27	15 N.	10 E.	Masonic Mng. Co., c/o Alice McIntosh, Roseville		
Maus Tunnel	36	14 N.	10 E.	W. H. Craig, Foresthill		R. XV, p. 364
Mayflower, et al.	15, 22 23, 24 25, 26 27	14 N. 14 N. 14 N. 14 N.	10 E. 10 E. 10 E. 10 E.	Mayflower Gravel Mining Co., c/o Richard Detert, 995 Market St., San Francisco	2,683	R. VIII, p. 457; IX, pp. 29, 120; X, p. 453; XII, pp. 210-11; XIII, p. 283; XV, pp. 364-365; Bull. 92, p. 137

McGeachin	3, 4 9, 10	14 N. 14 N.	10 E. 10 E.	McGeachin Placer Gold Mng. Co., c/o C. H. Dunn, Capital National Bank Bldg., Sacramento	1,698	Includes Morning Star, et al.
McManus River	----------	----------	----------	----------	----------	See Burns
Midas	28	16 N.	11 E.	Mrs. Minnie Stump, 100 Harrison Ave., Sausalito		
Missouri	33, 34	14 N.	10 E.	----------	----------	R. XV, p. 365
Mobile Hill & Campbell	4, 9	14 N.	10 E.	Mrs. Mary Mitchell, 404 28th St., Oakland	35	
Mohawk	26	15 N.	10 E.	N. E. Booth, Colfax	----------	R. XV, p. 365
Monumental	4	15 N.	13 E.	Peter F. Hinst, E. W. Smith & A. A. Bissell, Westville	200	R. XIII, p. 283; XV, pp. 365-366
Moody Ridge	3, 10	15 N.	10 E.	Mr. Moody, Pacific Hardware Co., San Francisco	120	R. VIII, p. 472; IX, p. 29; X, p. 240; XII, p. 211; XIII, p. 283; XV, p. 366
Morning Star	33, 34	15 N.	10 E.	McGeachin Placer Gold Mng. Co., c/o C. H. Dunn, Capital National Bank Bldg., Sacramento	163	R. VIII, pp. 472-473; IX, p. 29; X, p. 420; XII, p. 211; XIII, p. 283; XV, p. 366; XVIII, p. 45
Mountain Chief	34	14 N.	11 E.	Fred Outhouse, Foresthill	----------	R. XV, p. 366
Mountain Tunnel	3	13 N.	10 E.	A. C. Bequette, Auburn	220	
Mountain View	----------	----------	----------	Mrs. J. V. Watson, 2420 L St., Sacramento, et al.	90	
Muir Tunnel Cons.	15, 16	14 N.	11 E.	----------	469	See Forest Hill Mng. Corp.
New Baccarat	23	12 N.	6 E.	----------	160	R. XIII, pp. 283-84; XV, p. 366
New Basil Cons.	2, 3 10, 11	15 N. 15 N.	12 E. 12 E.	R. F. McLeod, 350 California St., San Francisco	380	R. XV, p. 368
New York & Refuge Canyon	9	14 N.	10 E.	Anna M. Schwab, Apt. 1, 1000 Oak St., San Francisco	72	
Nicholls Estate Co. Group	3, 4, 9 10, 15 34	15 N. 15 N. 16 N.	10 E. 10 E. 10 E.	Nicholls Estate Co., 612 Foxcroft Bdg., San Francisco	125	
North American	28	16 N.	11 E.	Mrs. F. D. Develey, c/o C. B. Thompson, Rio Vista	----------	R. XV, p. 368
North Bell	22	15 N.	10 E.	E. DeKruse and R. F. Cannon, Iowa Hill	----------	Field Report
North Fork and Bear River, Bear River Tunnel and 1,000 Ft. Claim	4 32, 35	15 N. 16 N.	10 E. 10 E.	Wm. Nicholls, Jr., 846 Mendocino Ave., Berkeley, et al.		
North Star	34	16 N.	10 E.	North Star Mng. Co., c/o E. J. Thomas, 564 Market St., San Francisco		
North Star, et al.	33	15 N.	10 E.	North Star Mng. Co., 404 28th St., Oakland, c/o Mrs. M. Mitchell	10	
Occidental	3 34	14 N. 15 N.	10 E. 10 E.	Occidental Mng. Co., c/o N. E. Wretman, 711 National Bank Bldg., San Jose	171	R. XV, p. 368
Orion and Rule	32	15 N.	10 E.	Estate of C. F. Macy, c/o W. S. Macy, Iowa Hill	80	
Oro	10	14 N.	11 E.	A. Dixon, Michigan Bluff	----------	R. XIII, p. 284; XV, p. 368
Oro Bell Dredge	----------	----------	----------	----------	----------	See Chenoweth Dredger
Oro and Dardanelles	27, 34 35 2, 3	14 N. 14 N. 13 N.	10 E. 10 E. 10 E.	Mayflower Gravel Mng. Co., c/o Richard Detert, San Francisco	313	
Oro & Mtn. View	14, 15 22, 23	15 N. 15 N.	10 E. 10 E.	Oro & Mtn. View Cons. Mng. Co., c/o W. H. Russell, Colfax	221	
Outhouse Cons.	24	15 N.	11 E.	Outhouse Cons. Mng. Co., Fred Outhouse, Pres., Foresthill	960	R. XV, p. 368
Pacific Blue Lead	----------	----------	----------	----------	----------	See Carmack

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TABLE OF PLACER MINES AND PROSPECTS, PLACER COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Pacific Gold Gravel	26	15 N.	12 E.	Pacific Gravel Gold Co., Michigan Bluff	160	R. XV, p. 371
Pacific Slab	33, 34	15 N.	12 E.	J. F. Thompson, Foresthill	170	R. XV, pp. 346-47; 369-70
Packard Twain, Packard Ext., Packard	1	15 N.	12 E.	H. L. Slosson, Jr.	300	
Paragon, Brecce & Wheeler, et al.	19, 24 30	14 N. 14 N.	11 E. 11 E.	J. F. Thompson, Foresthill	875	R. VIII, pp. 467-68; X, p. 455; IX, p. 29; XII, p. 206; XIII, p. 275; XV, pp. 347, 370-71; Bull. 92, pp. 136-137; XXXI, p. 20; U.S.G.S. Prof. Paper 73
Park & Brown	21	15 N.	13 E.	C. D. McKinley, Auburn, & A. Harmeson, Last Chance	160	R. XV, pp 377-78; XXI, p. 279
Pear Tree and Necessity	2	13 N.	9 E.	C. M. Langstaff, M. Savage, Foresthill		
Peckham Hill						See Mayflower Gravel Mng. Co.
Penn Valley	27	15 N.	10 E.	Mrs. B. T. Jamieson, 415 3d St., San Rafael	120	R. XV, p. 371
Pennsylvania	3	14 N.	10 E.	C. H. Freeman, 206 Foxcroft Bldg., San Francisco, et al.		
J. D. Peter's						See Gold Ring
Pine Avenue						R. XV, p. 382
Pine Nut	20	14 N.	13 E.	Fred C. Davidson and George Scherer, via Michigan Bluff	320	R. XV, pp. 378-79; XVIII, p. 603; XXI, p. 279
Pioneer Fluming Co.	9, 16 17, 20 21	14 N. 14 N. 14 N.	10 E. 10 E. 10 E.	Pioneer Fluming Co., c/o Geo. Stempel, 320 Fell St., San Francisco	157	
Pioneer Slope	25	14 N.	10 E.	W. H. Craig, Foresthill		
Pioneer Queen				Placer Queen Gold Mng. Co.		R. XV, p. 371
Pleasant Bar	33	14 N.	11 E.	E. Kavanaugh, 40 J St., Sacramento		R. XV, p. 382
Polar Star	34, 35	10 N.	10 E.	Wm. Nicholls, Jr., 846 Mendocino Ave., Berkeley	70	R. XV, p. 379
Polar Star, Little Bear, Southern Cross	34	16 N.	10 E.	Geo. V. Nicholls, et al., 2647 24th St., San Francisco		R. XV, p. 373
Pond	3, 4 33, 34	13 N. 14 N.	10 E. 10 E.	Kate T. Woolsey, c/o Trimble De Roode, 15 Murray St., New York	179	R. XV, p. 379
Potato Flatiron						R. XV, p. 383
Poverty Bar	35	13 N.	9 E.	Charles A. Fowler, 1051 47th St., Sacramento		
Protection	34	15 N.	13 E.	Glenn Cons. Mng. Co.	100	
Ralston Divide Gravel		13 N. 14 N. 13 N. 14 N.	12 E. 12 E. 13 E. 13 E.	California and Hawaiian Dev. Co., J. S. McCandless, Pres., 859 Mills Bldg., San Francisco		R. XV, pp. 371-372; XVII, pp. 450-51; Pre. Rep. 8, p. 36
Red Hill	26	13 N.	9 E.	J. E. & C. H. Walsh, Auburn	40	
Red Hill & Van Emon	22, 27	14 N.	11 E.	Walter S. Willy, Michigan Bluff		
Red Point						See Golden River
Red Star				D. M. Ray, Last Chance, & M. Savage, Foresthill		R. XV, p. 372; XXI, p. 280
Reed	8	15 N.	13 E.	J. D. Meredith, Capital National Bank Bldg., Sacramento	150	R. XV, p 372

Ritchie				Kate Voight, Adeline St., Oakland	90	
Robinson	26, 27 34	15 N. 15 N.	13 E. 13 E.	Estate of A. K. Robinson, Auburn		R. XXI, pp. 279-80
Robinson Flat, Screw Auger				W. S. Edwards		
Rocky Bar	1	14 N.	9 E.	O. L. Estey, Colfax		R. XV, p. 383
Rough & Ready	35, 36	14 N.	10 E.	Emma Williams, 3018 Encinal Ave., Alameda; G. H. Garrison, 715 I St., Sacramento, et al.		R. XV, p. 372
Sacramento				Mayflower Gravel Mng. Co., c/o Richard Detert, 995 Market St., San Francisco, et al.		R. XVIII, p. 263
Sailor Canyon	34	16 N.	13 E.	Sailor Canyon Gravel Mng. Co., W. H. Duffy, Supt., San Francisco		R. X, p. 426; XIII, p. 285; XV, p. 372
Sam Laird						See Laird River Claim
San Francisco	33, 34 3	14 N. 13 N.	10 E. 16 E.	San Francisco Placer Mng. Co., c/o Anglo-California Trust Co., San Francisco		R. XV, p. 383
Santa Fe				Morgan Green & Co., Auburn	10	R. XV, p. 372
Schlotman				Mrs. J. P. Just, 1209 E St., Sacramento		
Scott & Glacier	30	16 N.	12 E.	Towle Estate, Towle, California	160	
Sellier						R. XII, 213; XIII, p. 285; See Outhouse
Shackleton						See Shell Mine
Shady Lode	6	15 N.	13 E.	T. Ronneberg	160	
Shaw Brothers				Estate of Shaw Brothers		R. XIII, p. 285; XV, p. 372
Shelby	27	15 N.	10 E.	Mrs. Caprara, Grandview		
Shell				Perry and A. V. Shell, Blue Canyon		R. XV, p. 372
Small Hope	27	14 N.	10 E.	Mr. Federer and James Nicholson, Sacramento	40	R. XII, p. 212; XIII, p. 285; XV, p. 373
Small Hope and Arthur						R. XXXI, p. 21
Southern Cross	34	16 N.	10 E.	Geo. V. Nicholls, et al., 2647 24th St., San Francisco, et al.		R. XIII, p. 285; XV, p. 373
Spring Garden Cons.	5, 6, 7 8	13 N. 13 N.	10 E. 10 E.	N. W. Nash & H. W. Bradley, Sterling City	520	R. XV, p. 373
Starr	26	15 N.	12 E.	L. C. Hines, Westville, Mgr.		R. XV, p. 373
Star United	27	15 N.	10 E.	H. Gosch, Iowa Hill, Ben Rossi, 527 28th St., Sacramento, et al.	26	
Stewart, et al.	2, 3, 4 9, 10	15 N. 15 N.	10 E. 10 E.	Stewart Gravel Mines Co., c/o J. D. Stewart, 138 Commercial St., Auburn	630	R. XV, pp. 373-74
St. George	33	14 N.	10 E.	A. M. Colwell, Yankee Jim, Mgr.		R. XIII, p. 286; XV, p. 373
Strawberry	23, 26 27	15 N. 15 N.	10 E. 10 E.	John Watts, Jr., Colfax	211	
Success	13, 23 24	15 N. 15 N.	10 E. 10 E.	Estate of C. F. Macy, c/o W. S. Macy, Iowa Hill	280	
Succor Flat & Schilbach	25, 26 35, 36	15 N. 15 N.	10 E. 10 E.	John A. Ferguson, Foresthill		R. X, pp. 420, 422; XVIII, p. 211
Sumpter				W. E. Griggs, Iowa Hill	19	
Sunset and Riverside	14	15 N.	10 E.	P. W. Nicholson		
Swamp Angel	7, 10	16 N.	11 E.			R. XV, p. 384
Swift Shore	34, 35 2, 3	15 N. 14 N.	11 E. 11 E.	J. S. Vickford, Michigan Bluff		R. XV, p. 374
Tagpole Cons.	6	15 N.	13 E.	J. L. Sparkhawk, Iowa Hill	280	R. XV, p. 374
Theniss & Adams	1	14 N.	9 E.	Martin Theniss and P. C. Adams, Colfax		R. XV, p. 384
Truro	21, 22	15 N.	10 E.	Truro Mng. Co., Applegate, c/o G. C. Hepburn	100	R. XIII, p. 286; XV, p. 374

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* To save space, frequently only one of several names is shown in this column.

TABLE OF PLACER MINES AND PROSPECTS, PLACER COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Turkey Hill Consolidated	9, 10 15, 16	14 N. 15 N.	11 E. 11 E.	J. T. Williams, Michigan Bluff	270	R. X, p. 441; XII, p. 213; XIII, p. 286; XV, p. 374; XXXI, p. 20
Twenty-one	3, 10	14 N.	10 E.	O. F. Goodman		
Union	28	15 N.	10 E.	Wm. Hales, Newcastle, & son, Wm. Hales, 3400 43d St., Sacramento		R. XV, p. 374
Unison	35	16 N.	10 E.	J. H. Runckel, Dutch Flat	9	
Veteran	3, 4 34	15 N. 16 N.	12 E. 12 E.	Golden Fleece Gravel Mng. Co., 822 Foxcroft Bldg., San Francisco	640	
Volcano	18, 19 20	14 N. 14 N.	11 E. 11 E.	Mrs. Rosanna Scully, 104 W. Oak St., Stockton	135	R. XV, p. 374
Walsh	17	13 N.	10 E.	J. E. & C. H. Walsh, Auburn	113	
Washington						R. XIII, p. 286
Washington Gravel Mining Company						R. VIII, pp. 466-467
Waterhouse						R. X, p. 423; XV, p. 374; See Big Dipper
Watts Prospect	26	15 N.	10 E.	John Watts, Colfax		R. XIII, p. 286; XV, p. 374
Welcome Cons.	7, 8	14 N.	10 E.	Estate of T. L. Schwab, Iowa Hill	240	R. XV, p. 375
Weske						R. X, p. 441; XII, p. 213; XIII, p. 286; See Turkey Hill Cons.
Whipple & Bartlett	9	16 N.	11 E.	C. P. Hanson, 1215 Grand St., Alameda	160	
White Pine	27	15 N.	10 E.	Margaret G. Barrett, 222 2d Ave., San Francisco, & Mrs. E. Entwisle, c/o Hazel C. Kuhlman, 204 Washington St., Roseville	23	
Wild Yankee				F. K. Develey, Blue Canyon		R. XIII, p. 286; XV, p. 375
Willey, Batchelor, Bigelow				Mrs. Mary Dixon, 2322 W. St., Sacramento		
William Buchanan						See Buchanan
Wills	21	14 N.	11 E.	Estate of Mavis Wills, c/o J. A. Wills, Michigan Bluff		
Wisconsin						See Dyer
Wolverine	27	15 N.	10 E.	C. M. Coffing, 1615 I St., Sacramento	38	
X-Ray				F. Stevens, San Francisco	320	R. XV, p. 375
Yule & Willey, A. & E., Franklin				Alfred Dixon, 2322 W. St., Sacramento California		
Zelma Bell	19	14 N.	10 E.	Zelma Bell Mng. Co.	40	R. XV, p. 384

* To save space, frequently only one of several names is shown in this column.

SAN FRANCISCO FIELD DISTRICT

C. McK. LAIZURE, Mining Engineer

Reports covering the mines and mineral resources of all of the counties in the San Francisco field division are now available, and field work at present is confined to investigations for special reports upon various economic minerals.

LOS ANGELES FIELD DISTRICT

W. B. TUCKER and R. J. SAMPSON, Mining Engineers

Reports covering the mines and mineral resources of most of the counties in the Los Angeles field division are now available. Field work at present is confined to investigations for new reports upon Inyo and Mono counties.

GEOLOGIC BRANCH

CURRENT NOTES

Olaf P. Jenkins, Chief Geologist

Progress sheets of the new state geologic map of California, scale 1 : 500,000, are now being prepared for early publication. The state map will be divided into six parts, each 28 x 42 inches in size. Culture, streams, geologic contacts, and formation symbols will be shown for about 70% of the area of the state; further field work is needed to complete the rest of the geologic map.

In addition to the geologic sheets, plates are being constructed which show the principal highways and roads, contour lines, and the principal mines and mineral deposits.

Revision of Bulletin 91 ''Minerals of California'' is now in progress. This large task is being undertaken by Dr. Adolf Pabst, Professor of Mineralogy at the University of California. The clerical assistance is being provided from the relief rolls of the Works Progress Administration.

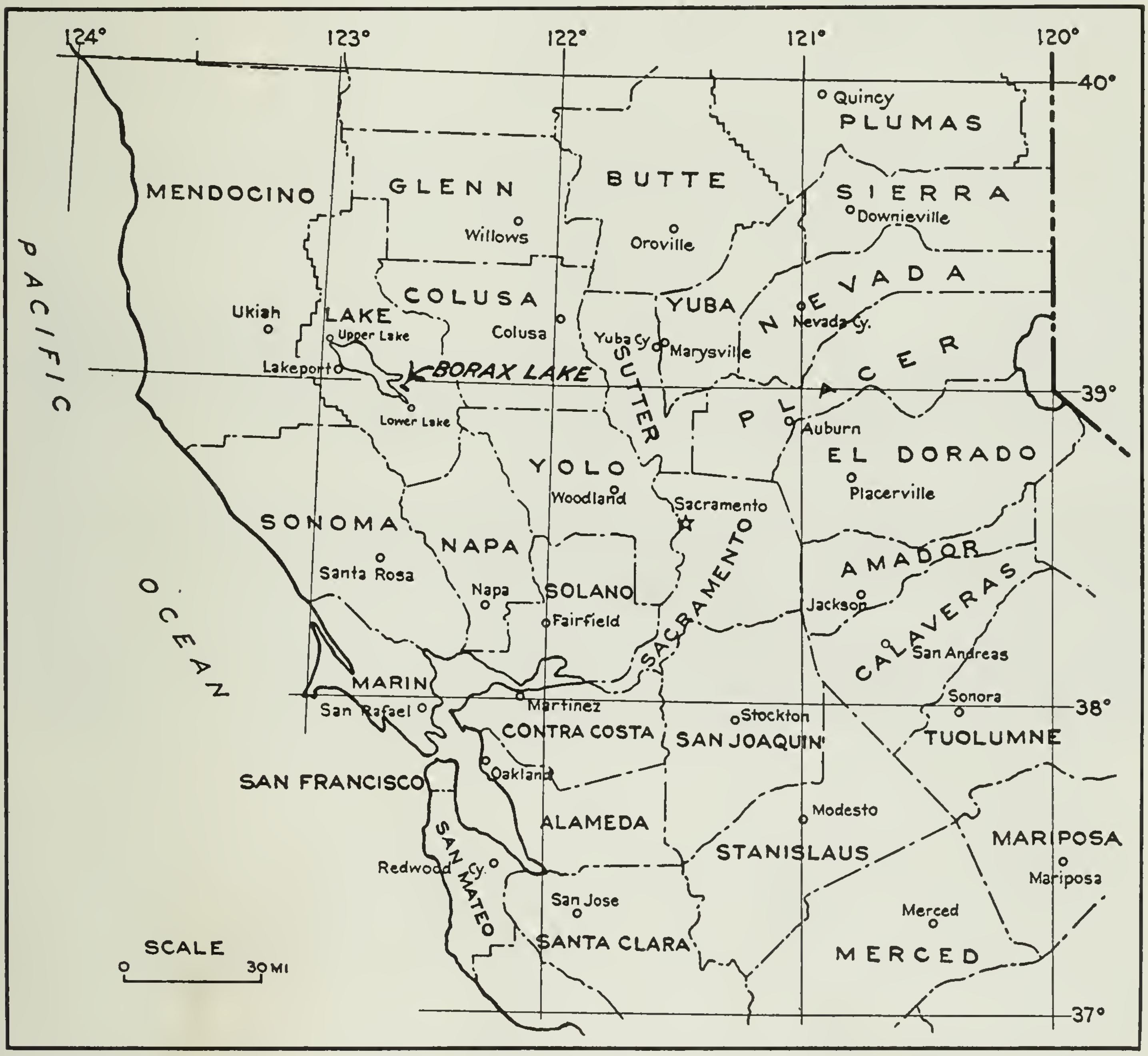
We gratefully acknowledge the generosity of Mr. M. Vonsen and Dr. G. D. Hanna of the California Academy of Sciences for contributing the following article on Borax Lake.

BORAX LAKE, CALIFORNIA

By M. VONSEN and G. D. HANNA, California Academy of Sciences

EARLY HISTORY

The discovery of borax in California was made by Dr. John A. Veatch[1] in January, 1856, who found the mineral in the waters of Tuscan Springs, eight miles east of Red Bluff, Tehama County (later referred to as "Lick Springs" by Dr. J. B. Trask). Dr. Veatch's attention was drawn to crystals formed by evaporation of spring water from an artificial pool. Later, in April, 1856, he was told of a smaller spring near the mouth of Pit River, forty miles to the north, where


124°
123°
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40°
39°
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37°
PACIFIC
OCEAN
Quincy
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
Downieville
Willows
Oroville
NEVADA
COLUSA
Ukiah
LAKE
Upper Lake
Colusa
YUBA
Yuba Cy.
Marysville
Nevada Cy.
Lakeport
BORAX LAKE
SUTTER
PLACER
Lower Lake
Auburn
YOLO
EL DORADO
Woodland
Placerville
Sacramento
SONOMA
NAPA
SACRAMENTO
Santa Rosa
AMADOR
Napa
SOLANO
Jackson
Fairfield
CALAVERAS
San Andreas
MARIN
Sonora
San Rafael
Martinez
Stockton
CONTRA COSTA
SAN JOAQUIN
TUOLUMNE
SAN FRANCISCO
Oakland
ALAMEDA
Modesto
STANISLAUS
MARIPOSA
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San Jose
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FIG. 1. Map of northern California showing location of Borax Lake.

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[1] An account of the finding is given in a letter by Dr. Veatch to the California Borax Company, dated June 28, 1857. It has been widely quoted in literature.

See J. Ross Browne & J. W. Taylor, Reports upon the mineral resources of the U. S. 1867, pp. 179–185, to which is added (pp. 186–187) an account of the methods of working the borax deposit.

J. Ross Browne, Mineral resources of the states and territories west of the Rocky Mountains: 1867, pp. 178–187.

H. G. Hanks, Report on the borax deposits of California and Nevada: Cal. State Min. Bur. 3rd Ann. Rept. pt. 2, 1883, pp. 15–20.

he subsequently found borates in solution. Examination of springs in the intermediate country also revealed small quantities of borate minerals in solution, which encouraged him to search further, and resulted in his finding borates in numerous other springs of the Coast Range. He noticed their occurrence most commonly in localities affected by volcanic disturbance.

From hunters and early settlers Dr. Veatch learned of many mineral springs, of sulphur and bitter waters, of lakes of soda, of alkali plains, of a lake of borax and a hill of white powder. Such reports fired his enthusiasm and strengthened his determination to continue the search for a deposit of commercial importance.

During 1856 and 1857 Dr. Veatch made several trips into Lake and western Colusa counties in quest of borate minerals. In the extreme western part of Colusa County he found the water of the spring bearing the Indian name ''Co-no-to-tok'' (probably Wilbur Springs) to be richly impregnated with common salt and borax. Eight miles to the west he found another spring rich in soda and carbonic acid gas, and containing a small quantity of boracic acid.

Nine miles farther west, in Lake County, he visited the ''white powder hill'' now known as ''Sulphur Bank.'' Upon examination it proved to be a mass of volcanic rock whitened by the action of sulphurous fumes. (In past years it has been a producer of sulphur, while more recently it has yielded large quantities of quicksilver.) Immediately south of Sulphur Bank, Dr. Veatch found boracic acid in solution in water flowing down a ravine.

Though considerably disappointed in the ''white powder hill,'' which he had supposed might be a ''treasure, in the form of borate of lime,'' Dr. Veatch decided to examine the surrounding country. He writes:

> "I learned, upon inquiry of Mr. Hawkins, who lives near the spot, that a place not far off known by the name of 'Alkali Lake,' presented a rather peculiar appearance. Hawkins consented to act as my guide. After traveling a short distance and clambering to the narrow edge of an almost precipitous mountain ridge, we looked down the opposite slope, equally steep, on a small muddy lake, that sent up, even to our elevated position, no pleasant perfumes. Thus, on one of the hottest days September ever produced, without a breath of air to dilute the exquisite scent exhaled from two hundred acres of fragrant mud, of an untold depth, I slid down the mountain side into 'Alkali Lake,' waded knee deep into its soapy margin, and filled a bottle with the most diabolical watery compound this side of the Dead Sea. Gathering a few specimens of the matter incrusting the shore, I hastened to escape from a spot very far from being attractive at the time, but which I have since learned to have no prejudice against."

During this first visit samples of mud were analyzed and found to contain borax. The finding of that mineral in ''Alkali Lake,'' or ''Lake Kaysa,'' as it had been named by the Indians, proved to be Dr. Veatch's most important discovery. More detailed examinations, made the next year, revealed the possibility of an immense borax production, and qualitative tests for iodine convinced Dr. Veatch that the lake was ''exceedingly rich'' in this element. Today ''Alkali Lake'' is known as ''Borax Lake,'' and has to its credit a period of vigorous production.

Borax Lake lies 114 miles north of San Francisco by road, on a peninsula projecting into the southeastern end of Clear Lake, Lake County. The triangular valley in which it is situated is enclosed on two sides by hills, which join at a point north of the valley and project well into Clear Lake.

Dr. Veatch described the lake as marsh-like in summer, covering an area of fifty or sixty acres, and consisting of a soapy mud topped by an incrustation of salt. In the winter, however, water covered approximately two hundred acres to a depth of three feet. The whole region bore marks of comparatively recent volcanic activity. From the volcanic ridge southeast of the lake, Dr. Veatch found hot sulphurous fumes still issuing.

Dr. W. O. Ayres,[2] superintendent of the California Borax Company, states that the practical development of Borax Lake began in 1864 and continued vigorously until 1868, when operations ceased, not on account of the exhaustion of the borax supply, but because of mismanagement. While the plant was working, Borax Lake supplied practically all the borax needs of the United States.

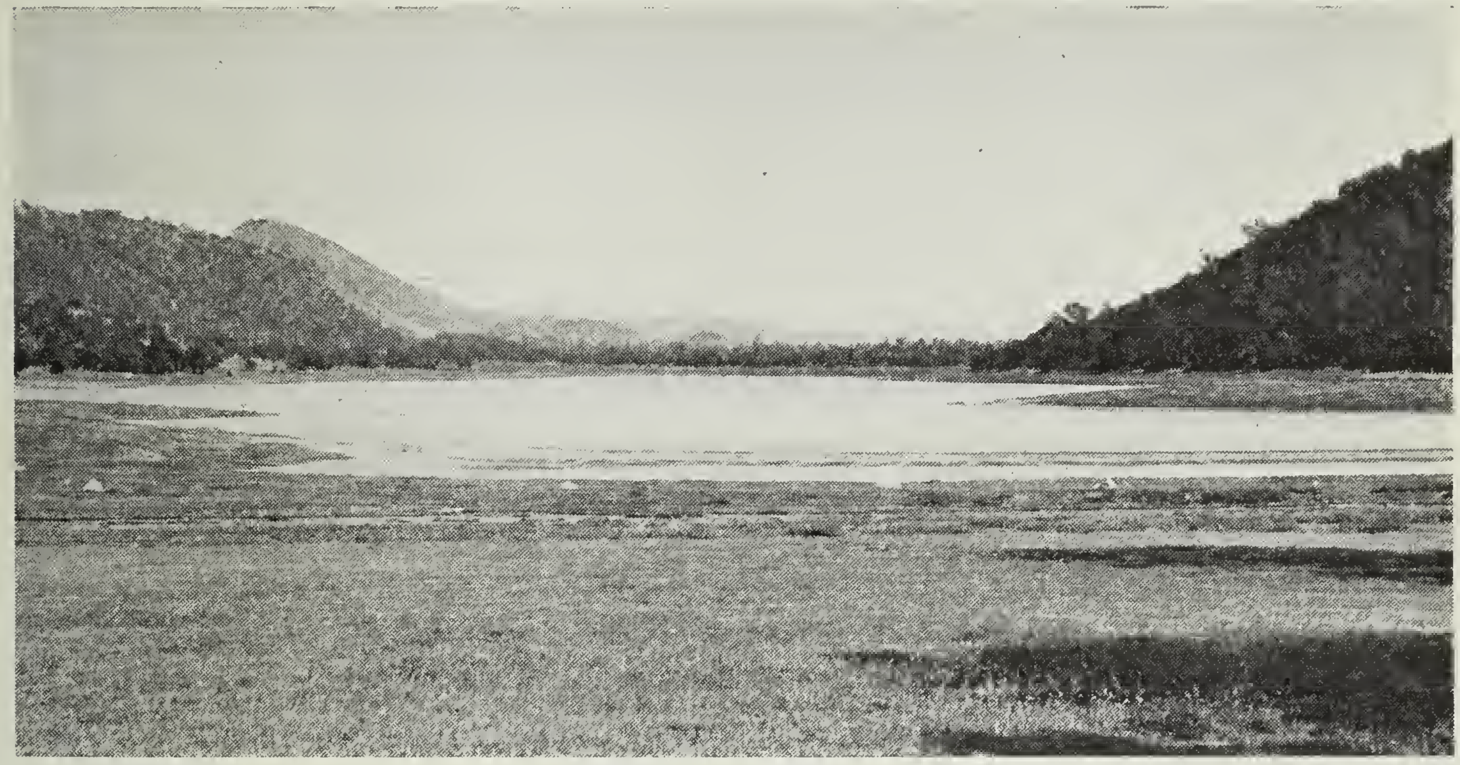

FIG. 2. Borax Lake, August, 1932, looking southeast.
Photo by Olaf P. Jenkins.

After the cessation of work at Borax Lake in 1868, activities were transferred to Hachinhama Lake, on the southwest side of Clear Lake, about four miles west of Borax Lake. Dr. Veatch described it briefly in his letter, but gave it no name. At the time of his visit the water was about three feet deep, and covered about twenty acres. The mud was of the same soap-like nature as that of Borax Lake; and though no borax crystals were found embedded in it, and the water contained less solid matter, the percentage of borax in solution was greater in proportion to other salts than in Borax Lake. Thirty-three per cent of the solids was borax.

From 1868 to 1873 Hachinhama Lake supplied all the American borax requirements. Borax was recovered (1) from the brine by a process of evaporation in small pans of two or three gallons each, and (2) as crystalline salts gathered in summer from the dry lake bed. During winter high-water periods the percentage of salts in solution remained the same as at low water, indicating an almost inexhaustible supply in the mud.

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[2] Ayres, W. O., Popular Science Monthly: vol. 21, July, 1882, pp. 350–361, 1 text fig. A portion of this report was quoted by H. G. Hanks, Cal. State Min. Bur. 3d Ann. Rept. pt. 2, 1883, pp. 20–24.

In 1874 an enormous amount of ulexite from beds in Nevada glutted the borate market, and caused a complete cessation of work in the Clear Lake region. The old, historic deposits have been idle ever since. Recently the Hachinhama Lake borax has been removed by a flood of fresh water pumped from Clear Lake.

ANALYSES

Water from Borax Lake has been analyzed on several occasions, most lately by R. C. Wells.[3] His sample was collected by Hoyt S. Gale in August, 1921, and yielded the following data, calculated on a gram ion per liter basis:

Ca	.06
Mg	.07
Na (diff.)	11.42
K	.56
Cl	11.60
SO_4	.05
HCO_3	2.54
CO_3	3.34
B_4O_7	.52
B_2O_4	1.42
	31.58

An analysis by Melville,[4] made in 1888, and converted to a percentage ion basis by F. W. Clark,[5] follows for comparison:

Cl	32.27
Br	.04
SO_4	.13
CO_3	22.47
PO_4	.02
B_4O_7	5.05
Na	38.10
K	1.52
Ca	.03
Mg	.35
SO_2	.01
Al_2O_3 Fe_2O_3 Mn_2O_3	.01

Other analyses have been published which differ somewhat in composition and concentration of materials.

In 1921, about the time that Gale's sample was collected, G. D. Hanna visited Borax Lake. The basin was then well filled, and the salts had not become concentrated enough to kill larvae of the *Diptera* which swarmed in the water.

MINERALS OF BORAX LAKE

Descriptions of Borax Lake, and the methods of working the borax deposits have been widely published.[6] Ayres[7] made a drawing showing the giant size and perfection of form of crystals obtained in the early days of commercial operations. With one or two exceptions the original specimens have long since disappeared, and even those which have been preserved in museums have turned white because of the loss of water. The authors have recently attempted to devise a method by which borax crystals may be preserved. The most promising appears to be to seal the specimens in a jar with a small amount of absorbent material moistened with brine. However, sufficient time has not yet elapsed to prove the experiment entirely successful.

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[3] Wells, R. C., Note on the water of Borax Lake: Jour. Wash. Acad. Sci., vol. 11, no. 20, Dec. 4, 1921, pp. 477–481.

[4] Becker, G. F., Quicksilver deposits of the Pacific Slope: U. S. Geol. Survey, Mon. 13, 1888, p. 265.

[5] Clark, F. W., Data of Geochemistry: U. S. Geol. Survey Bull. 770, 1920, p. 162.

[6] See in addition to the references already given:
Whitney, J. D., Geological Survey of California Geology: vol. 1, 1865, pp. 97–99.
Harris, R. P., On borax in California. Proc. Amer. Phil. Soc., vol. 9, 1865, p. 450.

It was not until the summer of 1934 that a favorable opportunity came for prospecting Borax Lake for giant borax crystals similar to those formerly found there. At that time, after two winters of light precipitation, almost all the water in the lake dried up—a condition not observed since 1861, when complete evaporation was reported.[8]

In August, 1934, Borax Lake was reduced to a mud flat partly covered with a white efflorescence. The little water remaining was, for the most part, encrusted with a pinkish sodium chloride, while in the center of the lake there remained about an acre of open water two or three inches deep, standing on light brownish trona beds.

When exploration work was started, planks had to be laid out on the mud surface for about fifty yards, for where the depth exceeded eighteen inches the material was too viscous to allow wading. Fifty yards out the heavy mud gave way to black ooze and brine beneath a thin crust of light pinkish salt. The ooze was probed with a garden rake, and from a depth of about two feet irregularly rounded masses of trona were extracted. They consisted of a shell about one-half an inch in thickness, which enclosed an interior of mud. Apparently the trona had been deposited in two stages. Many of the chunks were dark in color and impregnated with mud, bearing evidence of having at one time been partly dissolved. Attached to them was a later generation of crystals occurring as flat, thin, brownish, pinkish, or transparent plates, ranging from several millimeters to a centimeter in thickness. The older masses were quite difficult to clean, but mud was easily removed from the younger crystals by a gentle washing. Both generations were, for the most part, covered with pink or translucent white borax crystals.

A qualitative analysis of the trona showed a little magnesia, indicating the probable presence of northupite. It was later proved to be present by Mr. C. C. Church, when he dissolved the trona in water and found innumerable small translucent or perfectly white octahedrons half a millimeter or less in size, which, upon analysis, were found to consist of carbonate of magnesia and soda with chlorine.

Crystals of gay-lussite, the largest nearly a millimeter in length, were found to be much more numerous than those of northupite. Mixed with the two were some tiny orthorhombic crystals, tabular parallel to the brachypinacoid, with macrodomes; the macropinacoid was

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Keyes, W. S., Borax Lake and sulphur and quicksilver deposits near Clear Lake, California: Eng. & Min. Jour., vol. 22, 1876, p. 118.

Phillips, J. A., The alkaline and boracic lakes of California: Pop. Sci. Rev., vol. 16 (vol. 1, ser. 2), London, 1877, pp. 153–164. Kansas City Rev. Sci. & Ind., vol. 1, 1878, pp. 225–235. (An account of a personal visit to the lake in 1866.)

Becker, G. F., *op. cit.*, pp. 264–268, 464.

Anon., Potash in Borax Lake, Calif.: Eng. & Min. Jour., vol. 93, 1912, p. 643.

[7] *Op. cit.*

[8] Whitney, J. D., Geological Survey of California: Geol., vol. 1, 1865, p. 97.

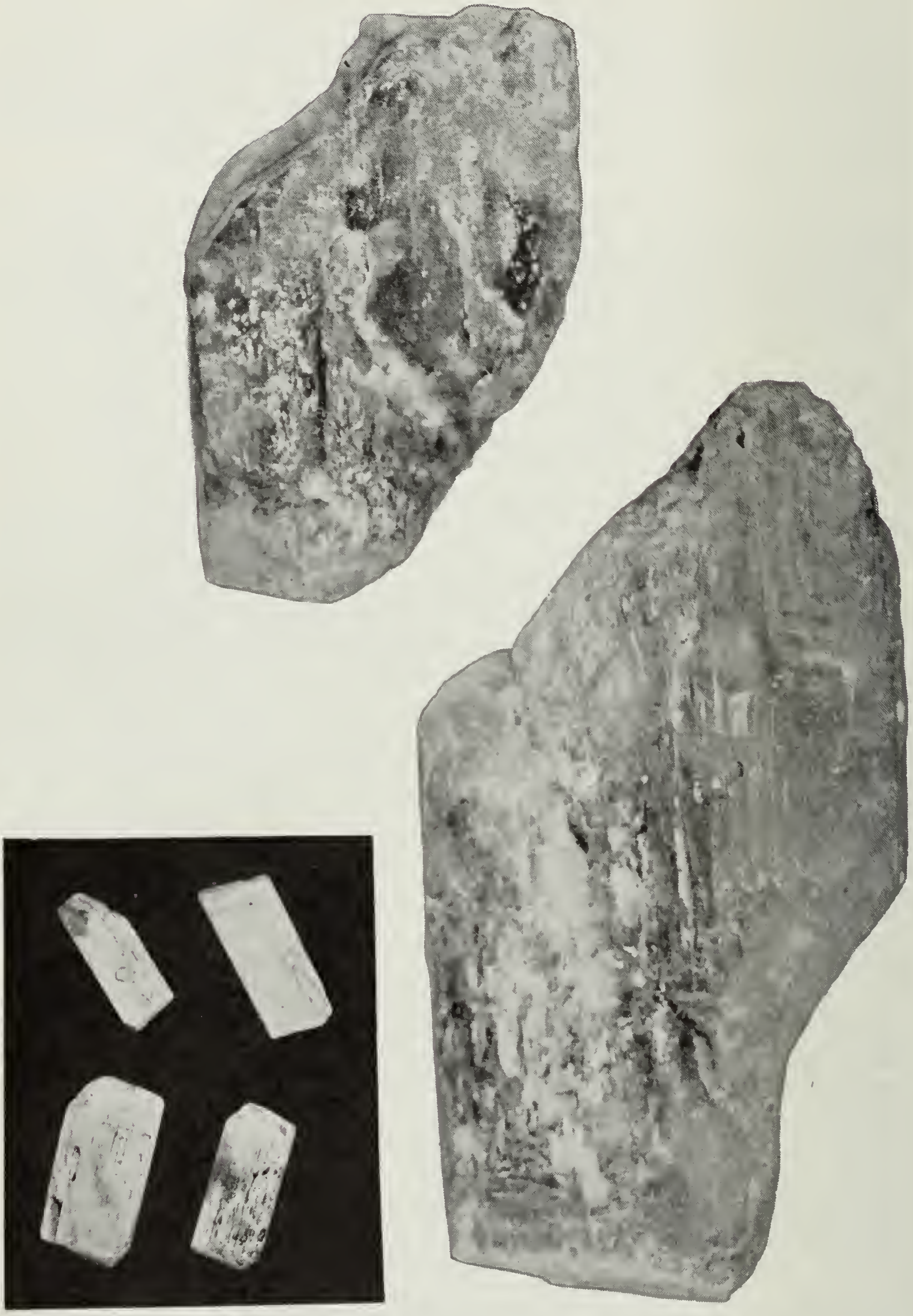

FIG. 3. Two of the largest crystals of borax found during the author's investigations, and a group of selected smaller ones. (Slightly reduced.)

Photo by Roy Rogers, January, 1936.

present on a few. Since the crystals were orthorhombic, and their highest index of refraction 1.57, they were readily distinguished from gay-lussite, and identified as pirssonite.

Analyses of the lake mud itself showed much smaller amounts of sulphates than were expected in a region of such a volcanic nature. Upon the addition of hydrochloric acid to a mud sample, the familiar odor of hydrogen sulphide was noted, as was its action on filter paper moistened with lead acetate. Since some ferric hydroxide was present in the ammoniacal solution, the reaction may have been due to the presence of the ferrous sulphide, hydrotriolite. In the region surrounding the lake, localities were frequently found where sulphurous fumes escaped, and sulphates were not uncommon in their near vicinity. Silliman[9] reports the sulphate glauberite as thin flattened tablets found in blue clay at a depth of forty feet in a boring made in the lake about 1868. Sulphur crystals were observed on the under side of a board near the east shore of the lake, during the exploration of 1934. Tests for phosphates gave only slight results, but the mud reacted strongly for calcium, magnesium, and carbon dioxide, possibly because of the presence of gay-lussite and northupite. Though no crystals of these minerals were found in the mud, many small white particles were distinguishable.

The gasses which escaped from Borax Lake were found to be readily combustible. A shallow hole dug near the southern end filled with methane gas which burned easily, while in the center of the lake gas from a hole made with a shovel handle burned for half an hour. Ammonia gas was encountered when a deep pit was dug near the south end of the lake.

To reach the center of the lake improvised skis were used. They were made from 1 by 6 inch boards, six feet in length, with a loop of rope for the shoes. With reasonable care a man of average weight could travel safely over the mud upon them.

Near the center of the lake the remains of an old cofferdam were found, filled to the level of the mud with strong brine. Upon the boards was a good crop of closely-crowded borax crystals as much as half an inch in length. An improvised caisson was sunk near by, and when the mud was excavated from its interior, a layer of blue clay was found at a depth of about five feet. From this clay a considerable number of prismatic borax crystals one to four inches in length were collected, in addition to an abundance of smaller ones, all of a light translucent gray to greenish color. Innumerable small crystals were likewise found near the eastern shore, from 18 inches to two feet below the surface—several pounds of them to the cubic foot of mud. Farther toward the center of the lake, in the watery ooze, borax was absent; but small crusts of light buff or nearly-white trona, apparently recently formed, were found at various depths.

Calcareous tufa beds having the appearance of deposits from springs of considerable size (difficult to account for under the existing conditions) once stood up, chimney-like, at the northeast margin of the lake. Now, however, most of them have been destroyed and hauled away.

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[9] Silliman, B., On the occurrence of glauberite at Borax Lake, California: Proc. Calif. Acad. Nat. Sci., vol. 3, 1868, p. 399.

In the center of the lake lay a number of trona beds, the largest being about 60 feet in length, and separated from those adjoining it by watery ooze crusted over with a thin shell of common salt. The area of the combined beds was between one and two acres; and the entire deposit was covered by about three inches of a thick brown-colored brine as viscous as maple syrup. The larger beds of trona were warped across their entire width, and consequently had been pushed up above the brine 12 to 18 inches, in hip-roof fashion. The sharp edge of the warped crusts had a thickness of three or four inches. The portion beneath the brine left an ideal place for minerals to crystallize. It was evident that the undersurface, where submerged in brine, had once been covered with halite crystals which had since been replaced by trona. The forms of the halite crystals were very well preserved and, indeed, remnants of halite were still visible in places; above water it was abundant.

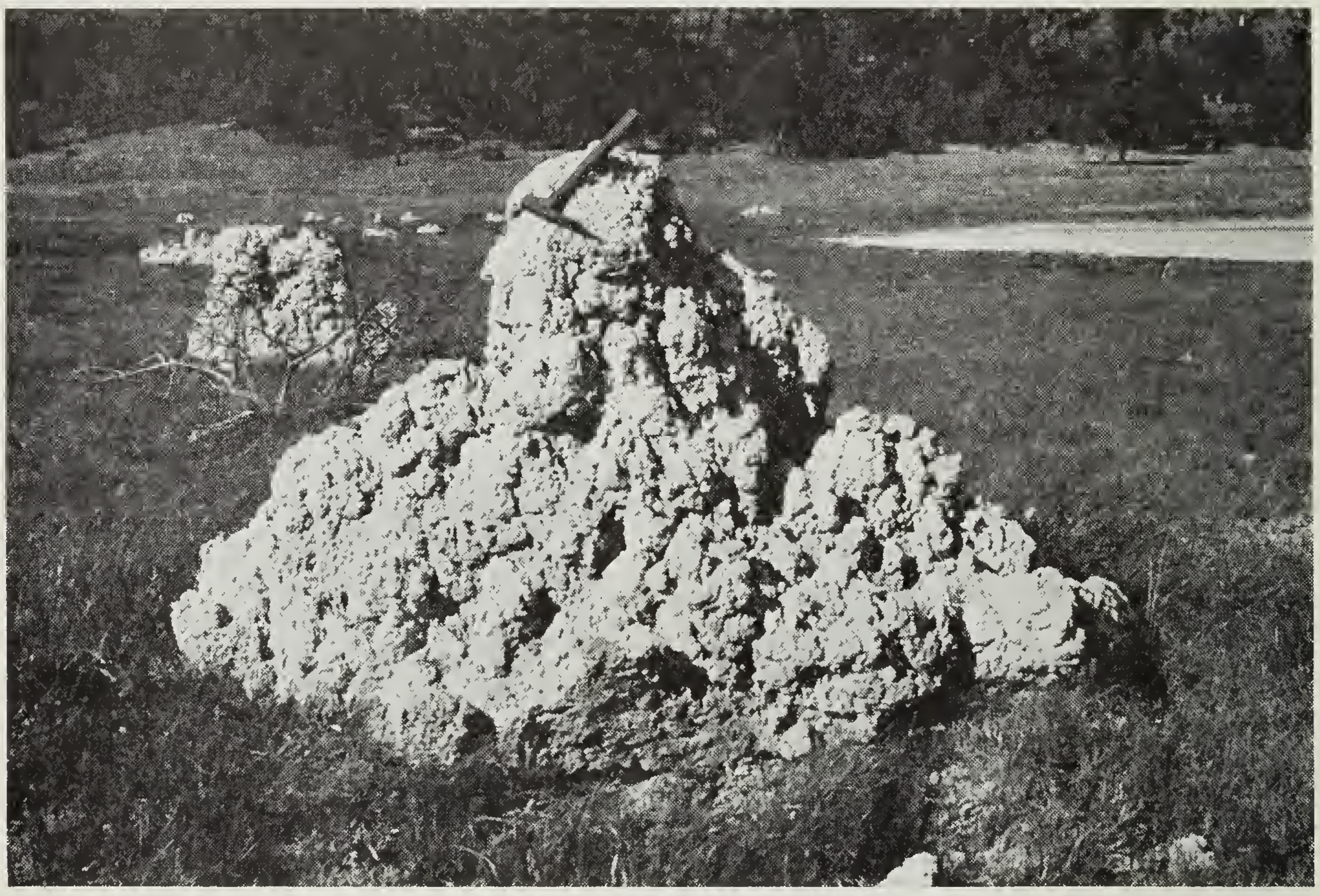

FIG. 4. Calcareous tufa deposit at the northeast end of Borax Lake.
Photo by Olaf P. Jenkins, August, 1932.

Trona on the elevated crusts consisted mostly of flattened drusy crystals, the sharp edge of each projecting outward. Attached to the trona were some thick glassy crystals, four to eight millimeters across, which were at first thought to be borax. After they had been exposed to the warm air for a few moments, however, they turned white and soft and could not be preserved. They were not identified, but may have been natron. No borax was found in these trona beds, nor was any one of the minerals, northupite, gay-lussite, or pirssonite present. The latter three minerals were found only in trona taken from the mud closer to shore. The massive trona from the center of the lake may be entirely a replacement of halite, as forms of halite crystals could be detected in the specimens collected.

On a very hot day several quarts of brine from this interesting part of the lake were collected, and, after having been kept in a cooler climate for a time, precipitated trona and other salts (some crystals of which have not yet been determined) which filled a third of a container. Tests run on the brine revealed a considerable quantity of iodine and potash, and the presence of bromine. Brine taken from pits nearer the shore carried smaller amounts of these elements.

During a later visit, made in October after cooler weather and several rains, the lake presented a somewhat different appearance. The hip-roof crusts had partly fallen in, and it was noted with interest that the halite had again started to crystallize, forming abundantly in the trona, which it replaced. The fresh, glassy-white cubic crystals characteristic of halite were well developed, and prismatic tetragonal rods (whose identity was at first in doubt, but which finally proved to be halite, too) were abundantly forming in the trona; the latter was much dissolved.

Careful observations over a period of several months led to the conclusion that as evaporation concentrated the brine in the center of Borax Lake, halite was first deposited; then as the solution became more heavily concentrated during the hot summer months, trona replaced the halite and formed heavy crusts. Later rains diluted the brine, reversing the order of things, and, as the trona began to dissolve, halite crystallized or replaced it; then, as the water continued to rise the halite also went into solution.

At times, when the water-level is relatively high and the concentration of salts not too great, insect larvae literally swarm in Borax Lake. Becker,[10] on the authority of C. V. Riley, reported them as the flies, *Ephydra californica* Packard, and a species of *Stratiomys.* Essig[11] gave an account of Ephydrid flies in 1926, and reported the species,

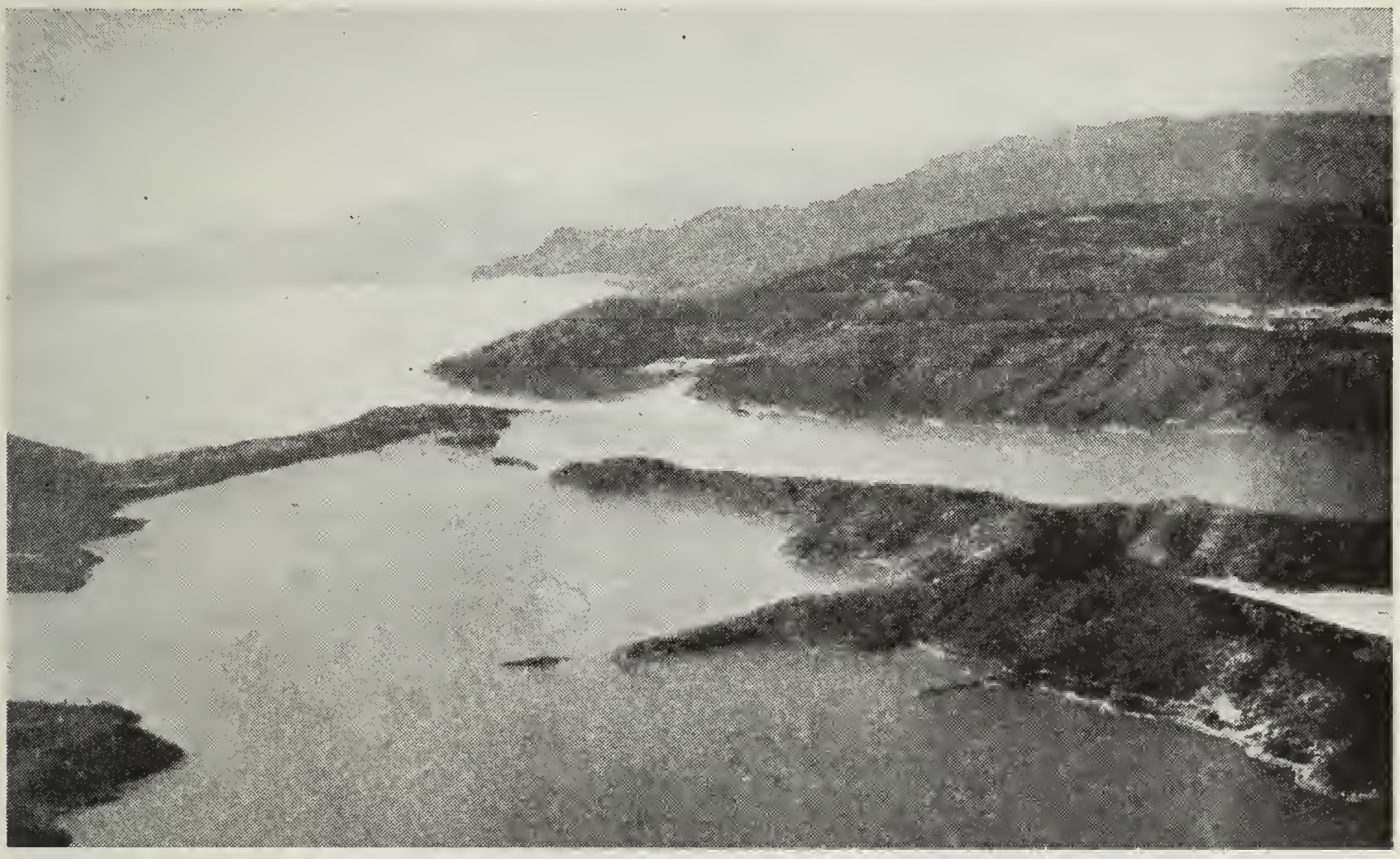

FIG. 5. Air-view of Clear Lake looking northwest from a point above Lower Lake. The white body to the extreme right shows a part of Borax Lake.

Photo by courtesy of Erickson, 'The Flying Photographer.'

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[10] Becker, G. F., *Op. cit.*, pp. 268–464.

[11] Essig, E. O., Insects of Western North America: MacMillan Co. 1926, p. 608–609, fig. 491.

Ephydra hians Say, from Borax Lake. He did not, however, mention *Stratiomys* in such a habitat, and it seems doubtful that the larvae of the genus actually live in the lake. The abundance of insects during normal stages of water probably explains the fact that the lake has been a favorite gathering place for ducks in the fall and winter. A low pass to the northwest, toward Clear Lake, was once the most frequent line of flight, and consequently became a popular station for hunters.

Mr. C. C. Church's examination of screenings from the washed mud disclosed a large number of shells of ostracods. There appeared to be but one species, and the stage of water at which the crustaceans lived is unknown.

Thanks are due Mr. Allyn G. Smith and Mr. John W. Cavanagh, as well as to Mr. C. C. Church, for their active assistance in collecting specimens and isolating minute crystals. Without the cooperation of these men it would have been quite impossible to gather material from the surface of the lake and the deeper muds.

OIL FIELD DEVELOPMENT OPERATIONS

R D. Bush, State Oil and Gas Supervisor

From September 29, 1935, to and including December 28, 1935, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
W. B. Caward and C. R. Edgecomb	6	20 S.	15 E.	7	Coalinga
Coawaca Petrol Corp.	14	20 S.	14 E.	2	Coalinga
James M. Conlon Co.	30	19 S.	15 E.	3	Coalinga
Kettleman North Dome Assoc.	20	21 S.	17 E.	27	Kettleman North Dome
Kettleman North Dome Assoc.	20	21 S.	17 E.	47	Kettleman North Dome
Kettleman North Dome Assoc.	20	21 S.	17 E.	87	Kettleman North Dome
Kettleman North Dome Assoc.	28	21 S.	17 E.	6	Kettleman North Dome
Kettleman North Dome Assoc.	28	21 S.	17 E.	43	Kettleman North Dome
Kettleman North Dome Assoc.	28	21 S.	17 E.	85	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	27	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	34	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	45	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	72	Kettleman North Dome
Standard Oil Co.	27	21 S.	17 E.	6	Kettleman North Dome
Standard Oil Co.	29	21 S.	17 E.	67	Kettleman North Dome
Standard Oil Co.	29	21 S.	17 E.	78	Kettleman North Dome
Standard Oil Co.	33	21 S.	17 E.	2	Kettleman North Dome
Standard Oil Co.	33	21 S.	17 E.	4	Kettleman North Dome
Standard Oil Co.	33	21 S.	17 E.	61	Kettleman North Dome
KERN COUNTY:					
Albert Beck Trust	35	28 S.	20 E.	Beck-Bacon 35-1	Belridge
Belridge Oil Co.	35	27 S.	20 E.	18-35	Belridge
Belridge Oil Co.	35	27 S.	20 E.	48A-35	Belridge
Belridge Oil Co.	1	28 S.	20 E.	6-1	Belridge
Union Oil Co.	36	27 S.	20 E.	Belridge 20	Belridge
General Petroleum Corp.	10	30 S.	29 E.	Speed 10-1	Edison
General Petroleum Corp.	24	30 S.	29 E.	Knapp 5	Edison
General Petroleum Corp.	24	30 S.	29 E.	Knapp 6	Edison
General Petroleum Corp.	24	30 S.	29 E.	Knapp 7	Edison
A. T. Jergins Trust	13	30 S.	29 E.	Fee 13-1	Edison
A. T. Jergins Trust	13	30 S.	29 E.	McCowan 13-A 8	Edison
A. T. Jergins Trust	13	30 S.	29 E.	McCowan 13-B 6	Edison
A. T. Jergins Trust	14	30 S.	29 E.	Hershey 2	Edison
A. T. Jergins Trust	24	30 S.	29 E.	Smithwick 3	Edison
North American Oil Consolidated	14	30 S.	29 E.	Brown 3	Edison
R. & R. Development Co.	29	30 S.	30 E.	R. & R. 1	Edison
Shell Oil Co.	14	30 S.	29 E.	Clare 4	Edison
Shell Oil Co.	15	30 S.	29 E.	Duff 4	Edison
Union Oil Co.	14	30 S.	29 E.	Dougherty 3	Edison
Elliott Core Drilling Co.	14	29 S.	27 E.	Elliott 1	Fruitvale
Pepper & Kaar	26	29 S.	27 E.	Nickel 1	Fruitvale
Western Gulf Oil Co.	21	29 S.	27 E.	Burlock 1	Fruitvale
Western Gulf Oil Co.	22	29 S.	27 E.	18-KCL-B	Fruitvale
Western Gulf Oil Co.	22	29 S.	27 E.	Price & Stewart 5	Fruitvale
Western Gulf Oil Co.	22	29 S.	27 E.	Price & Stewart 6	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Parker 3	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Sweitzer 4	Fruitvale
C. C. M. O. Co.	23	28 S.	27 E.	49	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	51	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	52	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	53	Kern River
McDonald and Dearin	10	28 S.	27 E.	1	Kern River
National Oil Co.	11	28 S.	27 E.	Standard 2	Kern River
National Oil Co.	11	28 S.	27 E.	Standard 3	Kern River
National Oil Co.	11	28 S.	27 E.	Standard 4	Kern River
The Texas Co.	23	28 S.	27 E.	Lehmann 15	Kern River
The Texas Co.	23	28 S.	27 E.	Lehmann 16	Kern River
The Texas Co.	23	28 S.	27 E.	Lehmann 17	Kern River
C. C. M. O. Co.	27	32 S.	23 E.	W. P. 2	Midway
C. C. M. O. Co.	27	32 S.	23 E.	W. P. 3	Midway
Caloren Oil Co.	27	32 S.	23 E.	Peters W. P. 1-B	Midway
Quality Oil Co.	27	32 S.	23 E.	W. P. 1	Midway
Standard Oil Co.	33	32 S.	24 E.	17	Midway
Falcon Oil Co.	27	26 S.	28 E.	Falcon 1	Mt. Poso
General Petroleum Corp.	16	27 S.	28 E.	Heisen 50	Mt. Poso
General Petroleum Corp.	21	27 S.	28 E.	Glide 21 4	Mt. Poso
Hugh L. Mann	33	26 S.	28 E.	Mann 1	Mt. Poso
Mariel Oil Co.	27	27 S.	28 E.	1	Mt. Poso
Shell Oil Co.	4	27 S.	28 E.	Matthew Fee 5	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 26	Mt. Poso

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
The Texas Co.	4	27 S.	28 E.	Alta Vedder 9	Mt. Poso
The Union Oil Co.	4	27 S.	28 E.	S. & M. 30	Mt. Poso
Zenith Oil Co.	35	27 S.	28 E.	1	Mt. Poso
Buffalo Oil Co.	19	30 S.	29 E.	1	Mountain View
Gilmore-Snyder Co.	24	30 S.	28 E.	Mullaney 4	Mountain View
The Hancock Oil Co.	14	30 S.	28 E.	Miller 8	Mountain View
The Hancock Oil Co.	14	30 S.	28 E.	Miller 9	Mountain View
Hogan Petroleum Co.	32	30 S.	29 E.	Wharton 5	Mountain View
Mohawk Petroleum Co.	30	30 S.	29 E.	C. W. Bloemer 2	Mountain View
Mohawk Petroleum Co.	30	30 S.	29 E.	Clendenen 7	Mountain View
Mohawk Petroleum Co.	30	30 S.	29 E.	Hood 8	Mountain View
The Ohio Oil Co.	33	30 S.	29 E.	Derby 3	Mountain View
Shell Oil Co.	32	30 S.	29 E.	Porter Two 3	Mountain View
Shell Oil Co.	32	30 S.	29 E.	Porter Two 5	Mountain View
Shell Oil Co.	32	30 S.	29 E.	Porter Two 6	Mountain View
Sheldon Oil Corp.	19	30 S.	29 E.	Ross 1	Mountain View
Standard Oil Co.	13	30 S.	28 E.	Abadie 2	Mountain View
Standard Oil Co.	13	30 S.	28 E.	Wilson 2	Mountain View
Standard Oil Co.	24	30 S.	28 E.	Mullaney 2	Mountain View
Standard Oil Co.	24	30 S.	28 E.	Mullaney 3	Mountain View
Standard Oil Co.	24	30 S.	28 E.	Mullaney 4	Mountain View
Standard Oil Co.	24	30 S.	28 E.	Ranton 7	Mountain View
Standard Oil Co.	24	30 S.	28 E.	Ranton 8	Mountain View
Union Oil Co.	23	30 S.	28 E.	Wible 5	Mountain View
Vesta Petroleum Co., Ltd.	19	30 S.	29 E.	Hopkins 9	Mountain View
Wood-Callahan Oil Co., Ltd.	25	30 S.	28 E.	Wells 2	Mountain View
Associated Oil Co.	4	28 S.	27 E.	6	Poso Creek
Gracekern Oil Co.	28	27 S.	27 E.	Gracekern 1	Poso Creek
Charles Hayes Kreigh	4	28 S.	27 E.	1	Poso Creek
O. & S. Oil Co.	32	27 S.	27 E.	1	Poso Creek
The Ohio Oil Co.	30	27 S.	27 E.	Newberry 1	Poso Creek
The Ohio Oil Co.	32	27 S.	27 E.	Midway Premier 8	Poso Creek
The Ohio Oil Co.	32	27 S.	27 E.	Midway Premier 9	Poso Creek
The Ohio Oil Co.	32	27 S.	27 E.	Midway Premier 10	Poso Creek
Oil Factors, Inc.	6	28 S.	27 E.	Premier Elliott 1	Poso Creek
Standard Oil Co.	5	28 S.	27 E.	5	Poso Creek
Standard Oil Co.	5	28 S.	27 E.	6	Poso Creek
Standard Oil Co.	5	28 S.	27 E.	7	Poso Creek
California Western Oil Co., Ltd.	7	28 S.	29 E.	14	Round Mountain
H. & L. Drilling Co., Inc.	2	28 S.	28 E.	1	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	91	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	92	Round Mountain
Shell Oil Co.	7	28 S.	29 E.	Caldwell 2	Round Mountain
Shell Oil Co.	17	28 S.	29 E.	Olcese 1–3	Round Mountain
Shell Oil Co.	17	28 S.	29 E.	Olcese 1–4	Round Mountain
Fullerton Oil Co.	25	27 S.	23 E.	77	Semitropic Gas
Fullerton Oil Co.	31	27 S.	24 E.	23	Semitropic Gas
Standard Oil Co.	14	27 S.	23 E.	Randolph Comm. 1	Semitropic Gas
Standard Oil Co.	16	27 S.	23 E.	Pioneer Fruit Co. 1	Semitropic Gas
Standard Oil Co.	16	27 S.	23 E.	Pioneer Fruit Co. 2	Semitropic Gas
Standard Oil Co.	36	27 S.	23 E.	Reading Fee 1	Semitropic Gas
Alford Oil Co.	25	12 N.	24 W.	Fried 2	Sunset
Chief Oil Co.	6	11 N.	23 W.	Maricopa 1	Sunset
General Petroleum Corp.	32	12 N.	23 W.	Midnorth 18	Sunset
General Petroleum Corp.	35	12 N.	24 W.	Moco 35–61	Sunset
Hallmark Oil Co., Inc.	35	12 N.	24 W.	3	Sunset
Petroleum Drilling & Exploration Co.	25	12 N.	24 W.	1	Sunset
Standard Oil Co.	36	12 N.	24 W.	M.J.M. & M. 61	Sunset
Standard Oil Co.	36	12 N.	24 W.	M.J.M. & M. 62	Sunset
R. E. Bering, Trustee	12	28 S.	19 E.	Maylan 2	
Caliente Oil Co.	31	29 S.	30 E.	2	
The Ohio Oil Co.	32	31 S.	26 E.	Kern County Land Co. A-4	
Reserve Oil and Gas Co.	2	10 N.	19 W.	Tejon Ranch 4	
Santa Carla Oil Co.	7	26 S.	28 E.	Glide 1	
Standard Oil Co.	1	25 S.	23 E.	Widgeon 3	
Standard Oil Co.	3	29 S.	29 E.	M. & T., Inc. 1	
KINGS COUNTY:					
Kettleman North Dome Assoc.	1	22 S.	17 E.	34	Kettleman North Dome
Kettleman View Oil & Gas Co.	29	22 S.	19 E.	Kettleman View 1	
Milham Exploration Co.	5	22 S.	19 E.	West Tulare 1	
Royalty Service Corp., Ltd	16	24 S.	18 E.	Spreckels 1	
Union Oil Co.	28	22 S.	20 E.	Hancock-Union Giannini 1	

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY:					
Shell Oil Co.	33	3 S.	13 W.	Reyes 82	Dominguez
Union Oil Co.	33	3 S.	13 W.	Callender 26	Dominguez
Union Oil Co.	33	3 S.	13 W.	Hellman 40	Dominguez
West American Oil Co.	3	4 S.	13 W.	Del Amo 1	Dominguez
Standard Oil Co.	8	2 S.	14 W.	Rubel 22	Inglewood
Standard Oil Co.	8	2 S.	14 W.	Rubel 23	Inglewood
Standard Oil Co.	8	2 S.	14 W.	Vickers 1-33	Inglewood
Standard Oil Co.	8	2 S.	14 W.	Vickers 1-34	Inglewood
Altco Oil Co., Inc.	29	4 S.	12 W.	Altco 1	Long Beach
Big 4 Oil Co.	19	4 S.	12 W.	2	Long Beach
R. R. Bush Oil Co.	19	4 S.	12 W.	Ideal 2	Long Beach
Chief Oil Co.	29	4 S.	12 W.	Chief 5	Long Beach
Davis Investment Co.	29	4 S.	12 W.	21	Long Beach
Freeman Oil & Gas Co., Inc.	19	4 S.	12 W.	1	Long Beach
Great Western Pacific Corp.	33	4 S.	12 W.	G. W. P. 3	Long Beach
Italo Petroleum Corp.	19	4 S.	12 W.	Italo 5	Long Beach
Orc Negro Oil Co.	20	4 S.	12 W.	Spath 1	Long Beach
Painted Hills Oil Co.	29	4 S.	12 W.	Painted Hills 1	Long Beach
Sankey Oil Co., Inc.	29	4 S.	12 W.	1	Long Beach
Shell Oil Co.	29	4 S.	12 W.	Cherry Hill Comm. 11	Long Beach
Shell Oil Co.	13	4 S.	13 W.	Amebco 1	Long Beach
Twentieth Century Oil Co.	29	4 S.	12 W.	Painted Hills 1	Long Beach
United Empire Petroleum, Inc.	19	4 S.	12 W.	Empire 5	Long Beach
Standard Oil Co.	1	2 S.	12 W.	Baldwin 79	Montebello
Standard Oil Co.	1	2 S.	12 W.	Baldwin 81	Montebello
Standard Oil Co.	2	2 S.	12 W.	Baldwin 82	Montebello
Universal Consolidated Oil Co.	5	2 S.	11 W.	N 3	Montebello
Yant Petroleum Corp.	1	3 N.	16 W.	Yant 5	Newhall
Union Oil Co.	27	2 S.	15 W.	Del Rey 12	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	King Vidor 14	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	King Vidor 15	Playa del Rey
General Petroleum Corp.	5	3 S.	11 W.	Santa Fe 26	Santa Fe Springs
General Petroleum Corp.	5	3 S.	11 W.	Santa Fe 44-A	Santa Fe Springs
Pedro Petroleum Corp.	6	3 S.	11 W.	Fulton 5	Santa Fe Springs
Standard Oil Co.	6	3 S.	11 W.	Weisel 20	Santa Fe Springs
Union Oil Co.	5	3 S.	11 W.	Farwell 7	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Alexander 29	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Alexander 30	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 74	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 94	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 95	Santa Fe Springs
Thomas R. Clark	6	4 S.	14 W.	Clark 1	Torrance
Oliver B. McDowell	35	3 S.	14 W.	McDowell Comm. 1	Torrance
Ralph J. Brown	4	2 S.	11 W.	Lapworth 2	
C. R. Butler	14	2 S.	10 W.	Butler 1	
International Oil Developers, Inc., Ltd.	34	5 N.	16 W.	Powell 302	
McAdams Exploration Co.	31	4 S.	13 W.	Palos Verdes 1	
Signal Oil and Gas Co.	4	2 S.	11 W.	Lapworth 1	
MADERA COUNTY:					
The Pure Oil Co.	6	10 S.	14 E.	Security Company 1	
The Pure Oil Co.	8	10 S.	14 W.	Chowchilla 2	
MERCED COUNTY:					
T. R. Murrell	8	10 S.	9 E.	1	
MONTEREY COUNTY:					
W. I. T. Syn.	31	22 S.	14 E.	Flentge 4	
ORANGE COUNTY:					
C. C. M. O. Co.	9	3 S.	9 W.	100	Brea-Olinda
Standard Oil Co.	13	3 S.	11 W.	Emery 60	Coyote Hills
Standard Oil Co.	24	3 S.	11 W.	Emery 61	Coyote Hills
Devine & Thomas Oil Co.	35	5 S.	11 W.	Adele 4	Huntington Beach
D. D. Dunlap Oil Co.	2	6 S.	11 W.	Kirk 1	Huntington Beach
D. D. Dunlap Oil Co.	14	6 S.	11 W.	Mills 4	Huntington Beach
Lucky Strike Oil Co., Ltd.	35	5 S.	11 W.	Lucky Strike 5	Huntington Beach
Macal Oil Co.	35	5 S.	11 W.	1	Huntington Beach
The Murbro Co.	35	5 S.	11 W.	1	Huntington Beach
W. C. W. Drilling Co.	35	5 S.	11 W.	W. C. W. 1	Huntington Beach
V. R. G. Wilbur	2	6 S.	11 W.	Twining 2	Huntington Beach
Henry S. Woolner	35	5 S.	11 W.	H. B. Fee 2	Huntington Beach
Commander Oil Co., Ltd.	29	6 S.	10 W.	Mesa 1	Newport
T. W. Cooke Drilling & Service Co.	36	3 S.	9 W.	Cooke 1	Richfield
Standard Oil Co.	36	3 S.	9 W.	Yorba Comm. 1	Richfield

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
SAN JOAQUIN COUNTY:					
Amerada Petroleum Corp.	15	2 S.	5 E.	F. D. L. 3	
Amerada Petroleum Corp.	23	2 S.	5 E.	Tracy 11–23	
SAN LUIS OBISPO COUNTY:					
I. L. Burch	3	10 N.	26 W.	Burch 1	
SAN MATEO COUNTY:					
Frank W. Royer	10	8 S.	3 W.	1	
SANTA BARBARA COUNTY:					
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 1–11	Capitan
Pacific Western Oil Co.	16	4 N.	29 W.	92–16	Elwood
Signal Oil and Gas Co.	16	4 N.	29 W.	Appleford 98–6	Elwood
Caroline C. Spalding	16	4 N.	29 W.	Blue Goose 93–12	Elwood
Shell Oil Co.	10	4 N.	29 W.	Hollister 2	Goleta
Anacapa Oil Corp.	28	4 N.	27 W.	Low 2	Mesa
Fred E. Cole	28	4 N.	27 W.	Cole 10	Mesa
Marmonte Oil Co.	16	4 N.	26 W.	Williams 1-B	Summerland
O. C. Field Gasoline Corp.	28	10 N.	33 W.	1	
SOLANO COUNTY:					
Trico Oil and Gas Co.	11	5 N.	1 W.	Pierce 1	
TULARE COUNTY:					
George Clark	31	23 S.	28 E.	May 1	
Kabella Oil Co.	12	23 S.	27 E.	H. A. Briggs 2	
VENTURA COUNTY:					
Bankline Oil Co.	3	3 N.	19 W.	Calumet B–2	Bardsdale
Duke Oil Corp.	7	3 N.	19 W.	D.O.C. 1	Bardsdale
Continental Oil Co.	12	4 N.	23 W.	Pirie 2	Ojai
Continental Oil Co.	15	3 N.	24 W.	Hobson 1	Rincon
Honolulu Oil Corp., Ltd.	7	3 N.	24 W.	56–2	Rincon
Neil C. Needham	7	3 N.	24 W.	Needham 3	Rincon
Shell Oil Co.	28	3 N.	23 W.	Edison 29	Ventura
Shell Oil Co.	29	3 N.	23 W.	Taylor 86	Ventura

SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of the new laws and official regulations and notices affecting the mineral industry.

A NEW MAGAZINE

The first number of the *California Conservationist,* official publication of the State Department of Natural Resources, was launched in January, 1936.

The Department of Natural Resources of which George D. Nordenholt is Director, consists of five divisions: Division of Fish and Game, Division of State Parks, Division of Forestry, Division of Mines, and Division of Oil and Gas.

The magazine is devoted to the conservation of these natural resources and it will also serve to acquaint the general public interested in all out-door activities with the work and accomplishments of the various divisions.

The *California Conservationist* is published monthly by the Department of Natural Resources, State Office Building, Sacramento. Subscription price $1 per year.

ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist

Personnel.

There have been no changes of personnel in the Division of Mines to be noted during the past three months.

New Publications.

'California Journal of Mines and Geology,' April, 1935, quarterly, being Chapter II of State Mineralogist's Report XXXI. This Chapter contains 'Geologic Section across the Southern Peninsular Range of California'; 'New Technic Applicable to the Study of Placers'; 'Preliminary Mine Financing—Grubstake Permits.'

'California Journal of Mines and Geology,' July, 1935, quarterly, being Chapter III of State Mineralogist's Report XXXI. This chapter contains 'Mines and Mineral Resources of Siskiyou County' (with map); 'Dams for Hydraulic Mining Debris'; 'Leasing System as applied to Metal Mines'; 'Mine Financing in California'; 'New Laws make Radical Change in Mining Rights.'

Commercial Mineral Notes, Nos. 151, 152, and 153, November and December, 1935, and January, 1936, respectively. These 'Notes' contain the lists of 'mineral deposits wanted,' and 'mineral deposits for sale,' issued in the form of a mimeographed sheet monthly. It is mailed free to those on the mailing list for 'California Journal of Mines and Geology.' and to others on payment of 15 cents postage paid in advance for the year. As an evidence of the interest in mines and mineral resources now showing considerable activity, this mimeographed 'sheet' has had to be expanded to two and three pages in recent months.

Mails and Files.

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products, and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main offce and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.

MINERALS AND STATISTICS

Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

STATISTICS

CALIFORNIA'S MINERAL PRODUCTION IN 1935 SHOWS INCREASE

The total value of the mineral production of California for the year 1935, just closed, is conservatively estimated by the Statistical Division as $256,938,000. This is in part, detailed in the tabulation below, but as there are more than 50 mineral substances on California's commercial list, it is impracticable at this early date to obtain definite figures on other than the more important items. The blank report forms are being mailed to the operators in all mineral lines, and the detailed and complete report will be compiled and published later.

The estimated total of $256,938,000 is an increase of approximately $19,563,000 over the value of the 1934 production, which was valued at $237,374,709. The principal increases in value of output over the previous year were shown by petroleum, gold, and natural gas; with lesser increases shown by brick and hollow building tile, miscellaneous stone, silver, quicksilver, copper, lead, other structural materials, and miscellaneous industrial materials. The only important mineral product that showed a decrease in amount and value was cement.

The value and amount of the petroleum output showed a marked increase over 1934, with a total quantity of about 203,005,000 bbls.—an increase of approximately 15%. The average price of all grades of crude oil was less than that for 1934, owing to a decrease in the prevailing prices at the end of August, with slight increases at the end of November and December, but not reaching the prices for the first eight months.

Receipts of bullion at the mint and smelters showed an increased output of gold of some 150,000 fine ounces over 1934. All the other major metals showed an increased yield, and with the exception of quicksilver this was directly due to the increased gold production as there were no mines in the state shipping copper or lead ores as such.

Of the structural group practically all the materials showed an increased output; this was accounted for by the fact that building permits in the principal cities of the state increased approximately 96% over the preceding year. The decrease in the cement output is due to decline in shipments to points outside the state.

The estimated value and quantities for 1935 are as follows:

$30,429,000	(869,000 fine ozs.) gold.
825,000	(1,118,000 fine ozs.) silver.
215,000	(2,550,000 lbs.) copper.
55,000	(1,380,000 lbs.) lead.
11,000	(240,000 lbs.) zinc.
636,000	(9,500 flasks) quicksilver.
275,000	other metals, including chromite, platinum, and tungsten ore.
175,036,000	(203,005,000 bbls.) petroleum.
15,151,000	(278,000,000 M. cu. ft.) natural gas.
9,924,000	(7,038,000 bbls.) cement.
7,850,000	crushed rock, sand and gravel.
1,891,000	brick and hollow building tile.
890,000	other structural materials, including bituminous rock, granite, magnesite, marble, sandstone, slate, etc.
4,500,000	miscellaneous industrial materials.
9,250,000	salines, including borates, potash, iodine, salt, soda, etc.
$256,938,000.	

MUSEUM

The Museum of the State Division of Mines possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Division of Mines as well as by those who utilize the facilities of the collection.

Among the specimens received recently and catalogued for the Museum are the following:

20645 DAMOURITE, a variety of muscovite $(H,K)AlSiO_4$ with euhedral quartz crystals. When fresh and moist resembles a ball of amalgam. From Utica Mine, Angels Camp, Calaveras County, California. Donor: Al C. Wilson, Utica Mining Company.

20646 BATEA. Made by Cayapas Indian, Equador. Donor: Pierre Larricq.

20647 CALIFORNITE (California jade). A variety of Vesuvianite from Stanshaw Hydraulic Mine, Somes Bar, Siskiyou County, California. Loaned by R. V. Montgomery and H. C. Kirkpatrick.

20648 SAPPHIRES (corundum) Gem quality. From 30 miles southwest of Philipsburg, Granite County, Montana.

20649 GARNETS (Montana Ruby) from Alder Gulch, Madison County, Montana. Donor: Jack Devenish.

20650 HEMATITE (Kidney ore). From Cumberland, England. Donor: John Melhase.

20651 EUXENITE AND POLYCRASE (Columbate and titanate of Y,Er,Ce,U) From Mattawan Township, Ontario, Canada. Donor: John Melhase.

20652 MALACHITE with Azurite (cut rough). From Bagday, Arizona. Donor: W. C. Eyles.

20653 SANDSTONE (Flexible). From North Carolina.

20654 DOLOMITE. Palos Verdes Estate, Los Angeles County. Donor: Mrs. Ann Lightburn.

20655 UTAHLITE (Lucinite). $A1PO_4.2H_2O$. From near Lucin, Boxelder County, Utah. Donor: Walter W. Bradley.

20656 XENOTIME $(V_2O_3.P_2O_3)$. Yttrium phosphate, and MONAZITE on black tourmaline. From Wm. Niendorff's ranch about 2 miles north of Winchester, Riverside County.

20657 ZIRCON $(Zr\ O_2.\ S_1O_2)$. Zirconium silicate. Clear crystals from CEYLON. Donor: W. C. Eyles.

20658 TOPAZ. Long waterworn crystal. From British Southwest Africa. Donor: W. C. Eyles.

20659 BRECCIATED JASPER (polished). From Stone Canyon, Monterey County, California. Donor: William B. Pitts.

20660 ORBICULAR JASPER (polished). From Santa Clara County, California. Donor: William B. Pitts.

20661 DOLOMITE (polished). From San Benito County, California. Donor: William B. Pitts.

20662 ENARGITE (Cu_3AsS_4), copper sulpharsenide. Assays gold 1 oz. per ton and copper 28%. From Kindaseki Gold Mine, Formosa. Donor: Gentaro Morisawa.

20663 SILVER-GOLD ORE (mostly galena and sphalerite). From Big Dyke Mine, Igo, Shasta County, California. Donor: N. H. Dyke.

LABORATORY

FRANK SANBORN, Mineral Technologist

The laboratory of the Division of Mines is maintained for the purpose of identifying minerals and making qualitative analyses of rocks. These determinations and analyses are made without cost to those who seek the services of this state department. Ordinarily, a small sample weighing not over half a pound, in the lump form if possible, should be submitted with a letter stating what particular tests are desired, if there is a special reason for sending the material. Not more than three samples should be sent at one time, nor is it necessary to send more than one. Information regarding the size of the deposit and its proximity to rail transportation is useful in determining the possible value of a mineral body.

When requested, assistance in finding a market for a mineral will be given. When such help is desired, a small representative sample of the material for which a market is sought should accompany the request. The Division is often able to send a very small sample of a particular mineral for comparative purposes to any earnest prospector. Very small pieces of certain silicates, such as andalusite, have been supplied to those desiring them.

Several thousand determinations are made annually by the Division of Mines, and prospecting and exploitation of the state's mineral wealth increases as the state becomes more thickly populated. Each year new occurrences of some mineral in the state are reported and occasionally a new mineral species is found. New uses for a mineral are frequently found, and as a result stimulus is given to searching for that particular substance.

LIBRARY

Herbert A. Franke, Librarian

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines contains over six thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, California Journal of Mines and Geology contains under this heading a list of all books and official reports and bulletins received which pertain particularly to mining in California.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED WHICH HAVE ESPECIAL INTEREST OR REFERENCE TO CALIFORNIA

U. S. Geological Survey:

Bulletin 869—Bibliography of North American Geology, 1933 and 1934. By E. M. Thom.

Water Supply Papers:

766—Part II—Pacific Slope Basins in California.
771—Floods in the U. S.—Magnitude and Frequency.
772—Studies of Relations of Rainfall and Run-off in the U. S.

Topographic Maps:

Arable Land of the Western U. S.

California:
Bartle Quadrangle.
Dark Hale Quadrangle.
Little Tujunga Quadrangle, Los Angeles Co.
Mt. Wilson Quadrangle, Los Angeles Co.
Reef Ridge Quadrangle.

U. S. Bureau of Mines:

Bulletin 388—Manufacture of Paraffin Wax from Petroleum. By R. H. Espoch.
Annual Report of the Director of the Bureau of Mines for Fiscal Year ended June 30, 1935.

Monograph 6—Flow of Natural Gas Through High-Pressure Transmission Lines. By Johnson and Berwald.

Report of Investigations:

3292—Factors that Decrease the Light of Electric Cap Lamps. By A. B. Hooker and D. H. Zellers.
3293—Benzene in Natural Gas. By H. H. Schrenk, W. P. Yant and S. J. Pearce.

Information Circulars:

6844—Jade. By Alice V. Petar.
6853—Questions and Answers on First-Aid Training. By J. J. Forbes and M. J. Ankeny.
6855—Accident Costs and Safety Dividends. By D. Harrington.
6856—Sand and Gravel Excavation: Part 4: Car and Locomotive Haulage: Hoist and Rope Haulage. Remote-Control Haulage. By J. R. Thoenen.
6857—Review of Literature on Effects of Breathing Dusts with Special Reference to Silicosis. Part III—A Chapter 5: Economic and Legal Aspects of Dust Disease in Industry (Section 1 and 2). By D. Harrington and Sara J. Davenport.
6858—Tabular Index of Bureau of Mines Information Circulars on Mining and Milling Methods. By J. R. Thoenen.
6861—Accident Experience and Cost in California Metal Mines. By S. H. Ash.
6867—Silicosis as Affecting Mining Workmen and Operations. By D. Harrington.
6869—Asbestos—Milling, Marketing and Fabrication. By Oliver Bowles.
6871—How to Use Permissible Explosives Properly. By D. Harrington and S. P. Howell.
6873—A Note on the Use of Ultra-Violet Lamps in Mines for Rapid Detection of Scheelite in Ores by Fluorescence. By Wm. O. Vanderburg.

U. S. Treasury Department:

Annual Report of the Director of the Mint, 1935.

U. S. War Department:

Report of the Chief of Engineers, U. S. Army, 1935.

New Books Received in State Division of Mines Library.

Getting Acquainted with Minerals. By G. L. English.
Low Cost Sawing, Grinding and Polishing Rig for Home Construction. By J. G. Ennes (Pamphlet).
Mineral Deposits. By W. Lindgren.
Structural Geology. By B. Stoces and C. H. White.
Thin-Section Mineralogy. By Rogers and Kerr.
A Treatise on Engineering Geology. By C. S. Fox.

New Books Received in John Hays Hammond Public Mining Library.

The World's Minerals. By L. J. Spencer.
Meteors. By C. P. Olivier.

PUBLICATIONS RECEIVED CURRENTLY AND FORMER REPORTS AVAILABLE FOR REFERENCE

Governmental, National.

U. S. Geological Survey:

Bulletins, Water-Supply Papers, Annual Reports, Professional Papers, Circulars, Monographs, Topographic Maps, and Special Publications.

U. S. Bureau of Mines:

Bulletins, Technical Papers, Economic Papers, Reports of Investigations, Information Circulars and Miners' Circulars.

Governmental, State.

Alabama Geological Survey, University.
Arizona Bureau of Mines, Tucson.
Arkansas Geological Survey, Little Rock.

Colorado Bureau of Mines, Denver.
Connecticut Geological and Natural History Survey, Hartford.
Florida Department of Conservation, Tallahassee.
Georgia Division of Geology, Atlanta.
Idaho Bureau of Mines and Geology, Moscow.
Illinois Geological Survey, Urbana.
Indiana Division of Geology, Indianapolis.
Iowa Geological Survey, Des Moines.
State Geological Survey of Kansas, Lawrence.
Kentucky Geological Survey, Frankfort.
Louisiana Department of Conservation, New Orleans.
Maine State Geologist, Augusta.
Maryland Geological Survey, Baltimore.
Michigan Geological Survey, Lansing.
Minnesota Geological Survey, Minneapolis.
Mississippi State Geological Survey, University.
Missouri Bureau of Geology and Mines, Rolla.
Montana Bureau of Mines and Geology, Butte.
Nebraska Geological Survey, Lincoln.
Nevada State Bureau of Mines, Reno.
New Jersey Department of Conservation and Development, Trenton.
New Mexico Bureau of Mines and Mineral Resources, Socorro.
North Carolina Geological and Economic Survey, Chapel Hill.
North Dakota Geological Survey, Grand Forks.
Ohio Geological Survey, Columbus.
Oklahoma Geological Survey, Norman.
Oregon Bureau of Mines and Geology, Corvallis.
Pennsylvania Topographic and Geological Survey, Harrisburg.
South Dakota State Geological Survey, Vermillion.
Tennessee Division of Geology, Nashville.
Texas Bureau of Economic Geology, Austin.
Virginia Geological Survey, University.
Washington State Department of Conservation and Development, Pullman.
West Virginia Geological Survey, Morgantown.
Wisconsin Geological and Natural History Survey, Madison.
Wyoming Geological Survey, Cheyenne.

Governmental, Foreign.

Alberta Research Council, Edmonton.
Argentina Direccion General de Minas y Geologica, Buenos Aires.
British Columbia Minister of Mines, Victoria.
British Museum and Natural History, London.
Canada Department of Mines, Ottawa.
Cuerpo de Ingenieros de Minas y Aguas del Peru, Lima.
Geological Service of Minas Geraes, Bella Horizonte, Brazil.
Geological Survey of Scotland.
Instituto Historica e Geographico, Rio de Janeiro.
Museo de Historia Natural de Montevideo, Uruguay.
New South Wales Department of Mines, Sydney, Australia.
New Zealand Geological Survey Branch, Wellington.
Nova Scotia Department of Public Works and Mines, Halifax.
Ontario Department of Mines, Toronto, Canada.
Quebec Bureau of Mines, Quebec.
Queensland Department of Mines, Brisbane, Australia.
South Australia Department of Mines, Adelaide.
Western Australia Geological Survey, Perth.
Transvaal Chamber of Mines, Johannesburg, South Africa.

Societies and Educational Institutions.

Academia de Ciencias y Artes de Barcelona, Spain.
Academy of Natural Sciences of Philadelphia.
American Association of Petroleum Geologists, Tulsa, Oklahoma.
American Geographical Society of New York.

American Institute of Mining and Metallurgical Engineers, New York.
American Journal of Science, New Haven, Conn.
American Philosophical Society, Philadelphia.
Australian Museum, Sydney.
California Academy of Sciences, San Francisco.
Canadian Institute of Mining and Metallurgy, Montreal.
Carnegie Institution of Washington.
Cleveland Museum of Natural History, Cleveland, Ohio.
Colorado College Publications, Colorado Springs.
Colorado Scientific Society, Denver.
Commonwealth Club, San Francisco.
Economic Geology, Lancaster, Pennsylvania.
Field Museum of Natural History, Chicago.
Franklin Institute of the State of Pennsylvania, Lancaster, Pennsylvania.
Geological Society of America, Columbia University, New York.
Geographical Society of London.
Institution of Mining and Metallurgy, London.
Instituto Geologico de Mexico, Mexico, D. F.
Journal of Geology, Chicago.
Mineralogical Society of America, Menasha, Wisconsin.
Michigan College of Mining and Technology, Houghton.
Mining and Metallurgical Society of America, New York.
Museu Nacional, Rio De Janeiro.
National Research Council, Washington, D. C.
New York Academy of Sciences, New York.
New York State Museum, Albany.
Pennsylvania State College, State College.
Philippine Journal of Science, Manila.
Royal Society of South Australia, Adelaide.
Seismological Society of America, Stanford University.
Sierra Club, San Francisco.
Society of Economical Paleontologists and Mineralogists, Fort Worth, Texas.
Southern California Academy of Sciences, Los Angeles.
University of California Publications in Engineering, Berkeley.
University of California Publications in Geography, Berkeley.
University of California Publications in Geology, Berkeley.
University of Harvard, Department of Mineralogy and Petrography, Cambridge, Mass.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
California Journal of Development, San Francisco.
California Mining Journal, Auburn.
California Oil World, Los Angeles.
California Safety News, San Francisco.
Canadian Mining Journal, Gardenvale, Quebec.
Chemical and Metallurgical Engineering, New York City.
Chemical Engineering and Mining Review, Melbourne, Australia.
Colorado School of Mines, Golden, Colorado.
Engineering and Mining Journal, New York City.
Fuel Oil, Chicago, Illinois.
Fusion Facts, Whittier, California.
Gold, Toronto, Canada.
Grizzly Bear, Los Angeles.
Hercules Mixer, Wilmington, Delaware.
Lubrication, The Texas Co., New York City.
Metals and Alloys, Pittsburg, Pennsylvania.
Mineralogist, Portland, Oregon.
Mining Congress Journal, Washington, D. C.
Mining and Industrial News, San Francisco.

Mining Journal, London.
Mining Journal, Phoenix, Arizona.
Mining and Metallurgy, New York City.
Mining Review, Salt Lake City.
Nickel Cast Iron News, New York City.
Northwest Science, Moscow, Idaho.
Northwest Mining, Spokane, Washington.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York City.
Oil Weekly, Houston, Texas.
Pacific Purchaser, San Francisco.
Petroleum World, Los Angeles.
Pit and Quarry, Chicago.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago.
Rocks and Minerals, Peekskill, New York.
Scientific American, New York City.
Southwest Builder and Contractor, Los Angeles.
Stabilizer, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York City.
Western Mining News, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Alaska Weekly, Seattle, Washington.
Amador Dispatch, Jackson, California.
Banner, Sonora, California.
Barstow Printer, Barstow, California.
Bridgeport Chronicle-Union, Bridgeport, California.
Calaveras Californian, Angels Camp, California.
Calaveras Prospect, San Andreas, California.
Colusa Sun-Herald, Colusa, California.
Daily Commercial News, San Francisco, California.
Daily Midway Driller, Taft, California.
Del Norte Triplicate, Crescent City, California.
Denver Mining Record, Denver, Colorado.
Georgetown Gazette, Georgetown, California.
Inyo Independent, Independence, California.
Inyo Register, Bishop, California.
Las Vegas Age, Las Vegas, Nevada.
Livermore Herald, Livermore, California.
Los Angeles Times, Los Angeles, California.
Mariposa Gazette, Mariposa, California.
Mercury Register, Oroville, California.
Mohave Miner, Kingman, Arizona.
Mojave-Randsburg Record, Mojave, California.
Morning Union, Grass Valley, California.
Mountain Messenger, Downieville, California.
Needles Nugget, Needles, California.
Nevada City Nugget, Nevada City, California.
Nevada Mining Bulletin, Las Vegas, Nevada.
Oil Marketer, Bayonne, New Jersey.
Placer Herald, Auburn, California.
Plumas Independent, Quincy, California.
San Diego News, San Diego, California.
Shasta Courier, Redding, California.
Siskiyou News, Yreka, California.
Stockton Record, Stockton, California.
Tehachapi News, Tehachapi, California.
Terra Bella News, Terra Bella, California.
Tuolumne Independent, Sonora, California.
Tuolumne Prospector, Tuolumne, California.
Union Democrat, Sonora, California.

Ventura County News, Ventura, California.
Waterford News, Waterford, California.
Weekly Trinity Journal, Weaverville, California.
Western Mineral Survey, Salt Lake City, Utah.
Western Sentinel, Etna Mills, California.

PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by this Division to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of *Mining in California* was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of CALIFORNIA JOURNAL OF MINES AND GEOLOGY, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.

PUBLICATIONS OF THE DIVISION OF MINES

During the past fifty-six years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the State, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have usually been limited, the reports and bulletins mentioned are printed in limited editions many of which are now entirely exhausted.

Copies of such publications are available for reference, however, in the offices of the Division of Mines, in the Ferry Building, San Francisco; State Building, Los Angeles; State Office Building, Sacramento; Redding; and Division of Oil and Gas at Santa Barbara, Taft, Bakersfield, Coalinga. They may also be found in many public, private and technical libraries in California and other states and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

Money orders should be made payable to the Division of Mines.

Purchasers in California add 3 per cent sales tax.

NOTE.—The Division of Mines frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

Asterisks (**) indicate the publication is out of print.

	Price[a]	Shipping Charges
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----	----
Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	$0.50	$0.10
Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	.50	.10
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----	----
Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	1.00	.15
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	1.00	.20
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:		
Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	.50	.10
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50	.10
Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	.25	.10
Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pp., paper	.50	.10
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35	.10
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915: A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:		
Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	.65	.10
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	.50	.05
Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper	.65	.10
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper	.65	.10
Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	.50	.10
Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	.65	.10

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[a] Purchasers in California, add 3 per cent sales tax.

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917: A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1917–1918, Fletcher Hamilton:		
Mines and Mineral Resources of Nevada County, 270 pp., paper	$0.75	$0.15
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50	.10
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50	.10
Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75	.25
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:		
**January, **February, March, April, May, June, July, August, September, October, **November, December, 1922	.25	.05
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	.25	.05
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California.' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy	.25	.05
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties	.25	.05
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties	.25	.05
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.25	.10
**October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties	----	----
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
**January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties	----	----
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial Counties	.25	.10
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties	.25	.05
**October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	----	----
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island	.25	.10
April, 1927, Mines and Mineral Resources of Amador and Solano Counties	.25	.05
**July, 1927, Mines and Mineral Resources of Placer and Los Angeles Counties	----	----
October, 1927, Mines and Mineral Resources of Mono County	.25	.05
Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1928, Mines and Mineral Resources of Tuolumne County	.25	.05
April, 1928, Mines and Mineral Resources of Mariposa County	.25	.05
July, 1928, Mines and Mineral Resources of Butte and Tehama Counties	.25	.05
October, 1928, Mines and Mineral Resources of Plumas and Madera Counties	.25	.05
Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
**January, 1929, Mines and Mineral Resources of Lassen, Modoc and Kern Counties; also on Special Placer Machines	----	----

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
April, 1929, Mines and Mineral Resources of Sierra, Napa, San Francisco and San Mateo Counties	$0.25	$0.10
July, 1929, Mines and Mineral Resources of Colusa, Fresno and Lake Counties	.25	.10
October, 1929, Mines and Mineral Resources of Glenn, Alameda, Mendocino and Riverside Counties	.25	.10
Chapters of Twenty-sixth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1930, Mines and Mineral Resources of Santa Clara County; also Barite in California	.25	.05
April, 1930, Mines and Mineral Resources of Nevada County; also Mineral Paint Materials in California	.25	.05
July, 1930, Mines and Mineral Resources of Yuba and San Bernardino Counties; also Commercial Grinding Plants in California	.25	.10
October, 1930, Mines and Mineral Resources of Butte, Kings and Tulare Counties; also Geology of Southwestern Mono County (Preliminary)	.25	.10
Chapters of Twenty-seventh Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1931, Preliminary Report on Economic Geology of the Shasta Quadrangle. Beryllium and Beryl. The New Tariff and Nonmetallic Products. Crystalline Talc. Decorative Effects in Concrete	.25	.10
April, 1931, Stratigraphy of the Kreyenhagen Shale. Diatoms and Silicoflagellates of the Kreyenhagen Shale. Foraminifera of the Kreyenhagen Shale. Geology of Santa Cruz Island	.25	.10
July, 1931. (Yuba, San Bernardino.) Feldspar, Silica, Andalusite and Cyanite Deposits of California. Note on a Deposit of Andalusite in Mono County; its occurrence and chemical importance. Bill creating Trinity and Klamath River Fish and Game District and its effect upon mining	.25	.10
October, 1931. (Alpine.) Geology of the San Jacinto Quadrangle south of San Gorgonio Pass, California. Notes on Mining Activities in Inyo and Mono Counties in July, 1931	.25	.05
Chapters of Twenty-eighth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1932, Economic Mineral Deposits of the San Jacinto Quadrangle. Geology and Physical Properties of Building Stone from Carmel Valley. Contributions to the Study of Sediments. Sediments of Monterey Bay. Sanbornite	.25	.10
**April, 1932. Elementary Placer Mining Methods and Gold Saving Devices. The Pan, Rocker and Sluice Box. Prospecting for Vein Deposits. Bibliography of Placer Mining	----	----
Abstract from April quarterly: Elementary Placer Mining Methods and Gold Saving Devices. Types of Deposits, Simple Equipment. Special Machines. Dry Washing. Black Sand Treatment. Marketing of Products. Placer Mining Areas. Laws. Prospecting for Quartz Veins. Bibliography (mimeographed)	.20	.05
July-October. (Ventura.) Report accompanying Geologic Map of Northern Sierra Nevada. Fossil Plants in Auriferous Gravels of the Sierra Nevada. Glacial and Associated Stream Deposits of the Sierra Nevada. Jurassic and Cretaceous Divisions in the Knoxville-Shasta Succession of California. Geology of a Part of the Panamint Range. Economic Report of a Part of the Panamint Range. Acquiring Mining Claims Through Tax Title. The Biennial Report of State Mineralogist	.50	.15
Chapters of Report XXIX, 1933 (quarterly: titled "California Journal of Mines and Geology," containing the following:		
January-April. Gold Deposits of the Redding and Weaverville Quadrangles. Geologic Formations of the Redding-Weaverville District, Northern California. Geology of Portions of Del Norte and Siskiyou Counties. Applications of Geology to Civil Engineering. The Lakes of California. Discovery of Piedmontite in the Sierra Nevada. Tracing		

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
'Buried River' Channel Deposits by Geomagnetic Methods. Geologic Map of Redding-Weaverville District, showing gold mines and prospects. Geologic Map showing various mines and prospects of part of Del Norte and Siskiyou Counties	$0.80	$0.15
July-October. Gold Resources of Kern County. Limestone Deposits of the San Francisco Region. Limestone Weathering and Plant Associations of the San Francisco Region. Booming. Death Valley National Monument, California. Placer Mining Districts, Senate Bill 480. Navigable Waters, Assembly Bill 1543	.80	.10
Chapters of Report XXX, 1934 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
January. Resurrection of Early Surfaces in the Sierra Nevada. Geology and Mineral Resources of Northeastern Madera County. Geology and Mineral Deposits of Laurel and Convict Basins, Southwestern Mono County. Notes on Sampling as Applied to Gold Quartz Deposits	.40	.10
April-July. Elementary Placer Mining in California and Notes on the Milling of Gold Ores	.80	.10
October. Current Mining Developments in Northern California. Current Mining Activity in Southern California. Geology and Mineral Resources of the Julian District, San Diego County. Geology and Mineral Resources of Elizabeth Lake Quadrangle. Dry Placers of Northern Mojave Desert. Biennial Report of State Mineralogist. Assessment Work Within Withdrawn Areas	.40	.10
Chapters of Report XXXI, 1935 (quarterly): titled "California Journal of Mines and Geology"		
January. Review of Gold Mining in East-Central, 1934. Current Mining Activities in the San Francisco District with Special Reference to Gold. Geological Investigation of the Clays of Riverside and Orange Counties Southern California. Information regarding Mining Loans by the Reconstruction Finance Corporation	.40	.10
April. A Geologic Section Across the Southern Peninsular Range of California. New Technique Applicable to the Study of Placers. Grubstake Permits	.40	.10
July. Mines and Mineral Resources of Siskiyou County (with map). Dams for Hydraulic Mining Debris. Leasing System as Applied to Metal Mining. Mine Financing in California. New Laws Make Radical Change in Mining Rights	.40	.10
October. Mines and Mineral Resources of San Luis Obispo County. Mineral Resources of Portions of Monterey and Kings Counties. Mining Activity at Soledad Mountain and Middle Buttes—Mojave District, Kern County. Geology of a Portion of the Perris Block, Southern California. Mineral Resources of a Portion of the Perris Block, Riverside County	.40	.10
Subscription, $1.75 postpaid in advance (by calendar year, only).		
Chapters of State Oil and Gas Supervisor's Report:		
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free	----
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:		
**April, **May, **June, **July, **August, **September, **October, **November, **December, 1919	----	----
**January, **February, **March, **April, **May, **June, **July, **August, **September, **October, **November, **December, 1920	----	----
January, **February, **March, April, **May, **June, **July, August, **September, **October, **November, **December, 1921	Free	----
January, February, March, April, May, June, **July, **August, September, **October, **November, December, 1922	Free	----
January, February, **March, **April, May, **June, **July, August, September, **October, November, **December, 1923	Free	----

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
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MISCELLANEOUS PUBLICATIONS

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**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----	----
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**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----	----
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OTHER MAPS

**Map of California, Showing Mineral Deposits (50 x 60 in.)	----	----
**Map of Forest Reserves in California	----	----
**Mineral and Relief Map of California	----	----
**Map of El Dorado County, Showing Boundaries, National Forests	----	----
**Map of Madera County, Showing Boundaries, National Forests	----	----
**Map of Placer County, Showing Boundaries, National Forests	----	----
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**Map of Sierra County, Showing Boundaries, National Forests	----	----
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Map of Western Portion of Siskiyou County Showing Location of Principal Gold Mines (accompanying July Chapter of Report XXXI), sold separately	.10	----

OIL FIELD MAPS

The maps are revised from time to time as development work advances and ownerships change.

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Map No. 21-A—Portion of District No. 4, showing boundaries of oil fields—Kern County	.75
Map No. 21-B—Portion of District No. 5, showing boundaries of oil fields—Fresno, Kings and Kern Counties	.75
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Map No. 47—Mountain View, Kern County	.75
Map No. 48—Mountain View and Edison, Kern County	1.25

DETERMINATION OF MINERAL SAMPLES

Samples (limited to two at one time) of any mineral found in the State may be sent to the Division of Mines for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the State. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

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STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
GEORGE D. NORDENHOLT, Director

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BADLEY State Mineralogist

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QUARTERLY CHAPTER
OF
STATE MINERALOGIST'S REPORT XXXII

STATE DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO,
CALIFORNIA

33041

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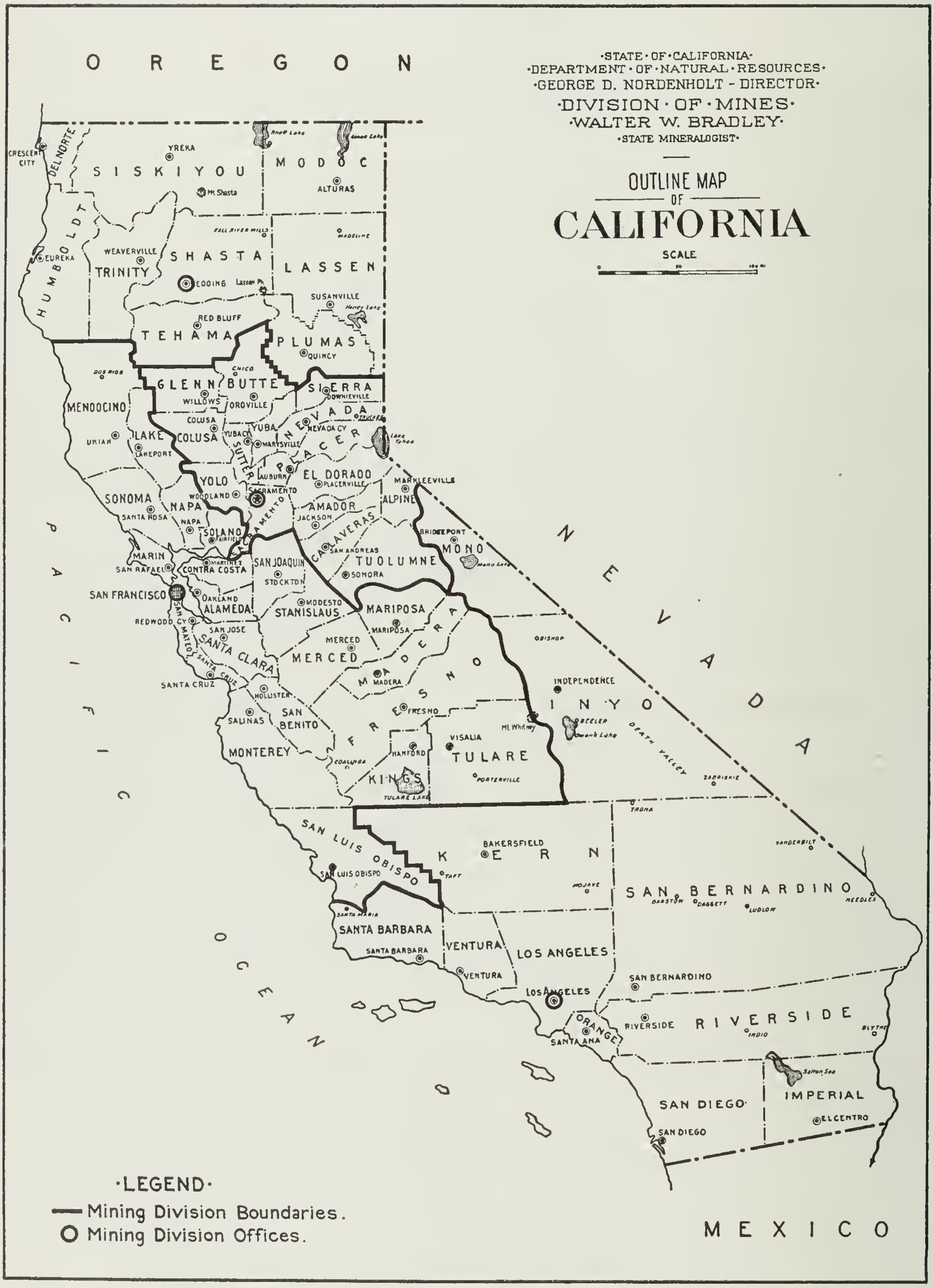

·STATE·OF·CALIFORNIA·
·DEPARTMENT·OF·NATURAL·RESOURCES·
·GEORGE D. NORDENHOLT - DIRECTOR·
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OUTLINE MAP
OF
CALIFORNIA

SCALE
OREGON
NEVADA
MEXICO
PACIFIC OCEAN
DEL NORTE
CRESCENT CITY
SISKIYOU
YREKA
Mt. Shasta
MODOC
ALTURAS
HUMBOLDT
EUREKA
TRINITY
WEAVERVILLE
SHASTA
REDDING
Lassen Pk.
LASSEN
SUSANVILLE
TEHAMA
RED BLUFF
PLUMAS
QUINCY
MENDOCINO
UKIAH
GLENN
WILLOWS
BUTTE
CHICO
OROVILLE
SIERRA
DOWNIEVILLE
COLUSA
LAKE
LAKEPORT
YUBA
SUTTER
NEVADA
NEVADA CY
PLACER
AUBURN
Lake Tahoe
YOLO
WOODLAND
SACRAMENTO
EL DORADO
PLACERVILLE
ALPINE
MARKLEEVILLE
SONOMA
SANTA ROSA
NAPA
SOLANO
FAIRFIELD
AMADOR
JACKSON
CALAVERAS
SAN ANDREAS
MONO
BRIDGEPORT
Mono Lake
MARIN
SAN RAFAEL
CONTRA COSTA
MARTINEZ
SAN JOAQUIN
STOCKTON
TUOLUMNE
SONORA
SAN FRANCISCO
OAKLAND
ALAMEDA
REDWOOD CY
SAN MATEO
STANISLAUS
MODESTO
MARIPOSA
SAN JOSE
SANTA CLARA
MERCED
MADERA
SANTA CRUZ
HOLLISTER
SAN BENITO
SALINAS
MONTEREY
FRESNO
INYO
INDEPENDENCE
BISHOP
Mt. Whitney
Owens Lake
DEATH VALLEY
KINGS
HANFORD
TULARE
VISALIA
PORTERVILLE
Tulare Lake
SAN LUIS OBISPO
KERN
BAKERSFIELD
TAFT
MOJAVE
SAN BERNARDINO
BARSTOW
DAGGETT
LUDLOW
NEEDLES
VANDERBILT
TRONA
SANTA BARBARA
SANTA MARIA
VENTURA
LOS ANGELES
ORANGE
SANTA ANA
RIVERSIDE
INDIO
BLYTHE
SAN DIEGO
IMPERIAL
EL CENTRO
Salton Sea
·LEGEND·
Mining Division Boundaries.
O Mining Division Offices.

PREFACE

The Division of Mines (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

As a progressive step in advancing the interests of the mineral industry, and as permitting earlier distribution to the public, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923. Owing to a lack of funds for printing this was changed to a quarterly publication, beginning in September, 1923. For the same reason, beginning with the January, 1924, issue, it became necessary to charge a subscription price. This covers approximately the cost of printing.

Pages are numbered consecutively throughout the year and an index to the complete report is included annually in the closing number.

Beginning with the 1930 issues, the activities and progress of the Geologic Branch are recorded also in these quarterly chapters. The important part that geology plays in the economic development of our mineral resources is further recognized in the change of title from *Mining in California* to CALIFORNIA JOURNAL OF MINES AND GEOLOGY, beginning with the January, 1933, chapter.

While current activities of all descriptions are covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters are subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

Types of Reports

In general the reports presented in these chapters are grouped into three classes:

1. Mines and mineral resources of a given county (describing kind, character, distribution and extent of development).
2. Specific economic and industrial mineral products (listing and describing the resources over the entire state of a given mineral substance, e.g., feldspar).
3. Geological reports on specific areas (recording results and conclusions, with maps, derived from field studies; and tied in with economic possibilities and developments).

REPORTS OF DISTRICT MINING ENGINEERS

In 1919–1920 the Mining Bureau was organized into four main geographical divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work, including lower traveling-expense bills for the Bureau's engineers. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions and the locations of the branch offices are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each district, prepared by the District Engineer, will continue to appear under the proper field division heading.

REDDING FIELD DISTRICT

Chas. V. Averill, Mining Engineer

There is no report from the Redding Field District. Mr. Chas. V. Averill, District Mining Engineer, is engaged on investigations for a special report upon the gold resources of Plumas County.

SACRAMENTO FIELD DISTRICT

C. A. Logan, Mining Engineer

On account of unfinished field work, there is no report from the Sacramento Field District in this issue.

SAN FRANCISCO FIELD DISTRICT

C. McK. Laizure, Mining Engineer

Reports covering the mines and mineral resources of all of the counties in the San Francisco field district are now available, and field work at present is confined to investigations for special reports upon various economic minerals.

LOS ANGELES FIELD DISTRICT

W. B. Tucker and R. J. Sampson, Mining Engineers

On account of unfinished field work, there is no report from the Los Angeles Field District in this issue.

GEOLOGIC BRANCH

CURRENT NOTES

By Olaf P. Jenkins, Chief Geologist

The following manuscripts and maps are being edited by the Geologic Branch and will soon be ready for the printer:

(1) Geology of Newberry and Ord Mountains, by Dion Gardner.
(2) Geology of San Nicolas and Santa Barbara Islands, by Luis E. Kemnitzer.
(3) Preliminary issue of the Geologic Map of California (geologic boundaries and symbols only), scale 1 : 500,000, by Olaf P. Jenkins.

The following manuscripts and maps are now in preparation:

(1) Bibliography of the geology and mineral resources of California for the years 1931–1935, inclusive, by Solon Shedd.
(2) Minerals of California (revision of Bulletin 91), by Adolph Pabst.
(3) Topographic map of California, scale 1 : 500,000, adapted from sectional airway maps made by the United States Coast and Geodetic Survey.
(4) Road map of California (to be used in connection with the geologic map), scale 1 : 500,000.
(5) Economic mineral map of California, scale 1 : 500,000.
(6) Fossil locality map of California, scale 1 : 500,000, to be prepared by Hubert Schenck.

An extensive card catalog is now being prepared which will form a complete geographic index to the State of California.

In the preparation of the above maps and reports, much assistance has been received from a personnel provided through the funds of the Works Progress Administration. In addition to this work, the Division of Mines has been engaged in supervising the accumulation and filing of mining and geologic data from many different sources. A complete record is being made of all mining claims and properties from records and plats available in the various county recorders offices and the United States Land Offices.

OIL FIELD DEVELOPMENT OPERATIONS

R. D. Bush, State Oil and Gas Supervisor

From December 29, 1935, to and including March 28, 1936, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
FRESNO COUNTY:					
King-McCray Oil Co.	14	20 S.	14 E.	Gralan 1	Coalinga
King-McCray Oil Co.	14	20 S.	14 E.	Thompson 2	Coalinga
Kolingo Drilling Co.	11	20 S.	14 E.	1	Coalinga
Pilot Oil Co.	12	20 S.	14 E.	12	Coalinga
Trojan Oil Co.	35	20 S.	14 E.	Trojan 1	Coalinga
Kettleman North Dome Assoc.	18	21 S.	17 E.	38	Kettleman North Dome
Kettleman North Dome Assoc.	20	21 S.	17 E.	2	Kettleman North Dome
Kettleman North Dome Assoc.	20	21 S.	17 E.	65	Kettleman North Dome
Kettleman North Dome Assoc.	30	21 S.	17 E.	72	Kettleman North Dome
Kettleman North Dome Assoc.	30	21 S.	17 E.	74	Kettleman North Dome
Kettleman North Dome Assoc.	30	21 S.	17 E.	76	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	43	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	47	Kettleman North Dome
Standard Oil Co.	27	21 S.	17 E.	38	Kettleman North Dome
Seaboard Oil Corp. of Delaware	10	16 S.	13 E.	Welsh 1	
Seaboard Oil Corp. of Delaware	30	16 S.	14 E.	Lillis 1	
Standard Oil Corp. of Delaware	13	20 S.	18 E.	Boston Land 1	
Western Gulf Oil Co.	3	17 S.	15 E.	S. P. Land Co. 3	
HUMBOLDT COUNTY:					
Cape Mendocino Oil Co., Ltd.	21	1 S.	2 W.	2	
The Texas Co.	22	3 N.	1 W.	Eureka 2	
IMPERIAL COUNTY:					
Imperial Carb-Ice Corp.	2	11 S.	13 E.	3	
KERN COUNTY:					
Belridge Oil Co.	35	27 S.	20 E.	17-35	Belridge
Continental Oil Co.	36	27 S.	20 E.	Result 7	Belridge
Standard Oil Co.	36	27 S.	20 E.	McPhail 4	Belridge
Bauer Oil Co.	21	30 S.	29 E.	Bauer 2	Edison
Berry Holding Co.	10	30 S.	29 E.	Grayson 2	Edison
Buckeye Union Oil Co.	22	30 S.	29 E.	Hay 1	Edison
R. E. Corbett	23	30 S.	29 E.	Rose 1	Edison
General Petroleum Corp.	11	30 S.	29 E.	Speed II 51	Edison
General Petroleum Corp.	24	30 S.	29 E.	Knapp 9	Edison
A. T. Jergins Trust	14	30 S.	29 E.	Hershey 12	Edison
A. T. Jergins Trust	14	30 S.	29 E.	Hershey 13	Edison
A. T. Jergins Trust	22	30 S.	29 E.	Brandt 6	Edison
A. T. Jergins Trust	23	30 S.	29 E.	W. H. Andrews 1	Edison
A. T. Jergins Trust	23	30 S.	29 E.	W. H. Andrews 7	Edison
A. T. Jergins Trust	24	30 S.	29 E.	Johnson 1	Edison
Monterey Exploration Co.	14	30 S.	29 E.	Citizens 1	Edison
Union Oil Co.	13	30 S.	29 E.	Brockman 2	Edison
Union Oil Co.	14	30 S.	29 E.	Dougherty 4	Edison
Whittier Santa Fe Springs Oil Co.	21	30 S.	29 E.	Edison 1	Edison
Dixie Lee Oil Co.	23	29 S.	27 E.	2	Fruitvale
Dixie Lee Oil Co.	23	29 S.	27 E.	3	Fruitvale
General Petroleum Corp.	22	29 S.	27 E.	Hensley 2	Fruitvale
Magnet Oil Co.	21	29 S.	27 E.	Anderson 2	Fruitvale
Mohawk Petroleum Co.	23	29 S.	27 E.	Osborn 1	Fruitvale
The Texas Co.	26	29 S.	27 E.	KCL 1	Fruitvale
Western Gulf Oil Co.	22	29 S.	27 E.	19-KCL-B	Fruitvale
Western Gulf Oil Co.	22	29 S.	27 E.	20-KCL-B	Fruitvale
Western Gulf Oil Co.	22	29 S.	27 E.	21-KCL-B	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Red Ribbon Ranch 2	Fruitvale
C. C. M. O. Co.	23	28 S.	27 E.	54	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	55	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	56	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	58	Kern River
General Petroleum Corp.	14	28 S.	27 E.	Wetmore 10	Kern River
General Petroleum Corp.	14	28 S.	27 E.	Young 5	Kern River
Hjorth & Gordon	36	28 S.	27 E.	Rosann 1	Kern River
The Kern River Oilfields of Calif., Ltd.	25	28 S.	27 E.	25-1B	Kern River
Lloyd Oil Co.	3	28 S.	27 E.	Lloyd 1	Kern River
Republic Petroleum Co., Ltd.	11	28 S.	27 E.	Fleishacker 1	Kern River
Republic Petroleum Co., Ltd.	24	28 S.	27 E.	Strassburger 6	Kern River
Republic Petroleum Co., Ltd.	24	28 S.	27 E.	Strassburger 7	Kern River
Republic Petroleum Co., Ltd.	24	28 S.	27 E.	Strassburger 9	Kern River

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued					
Standard Oil Co.	24	28 S.	27 E.	Ward Fee 1	Kern River
Standard Oil Co.	24	28 S.	27 E.	Ward Fee 2	Kern River
The Texas Co.	23	28 S.	27 E.	Lehmann 13	Kern River
The Texas Co.	23	28 S.	27 E.	Lehmann 14	Kern River
The Texas Co.	23	28 S.	27 E.	Lehmann 18	Kern River
Vega Oil Co.	11	28 S.	27 E.	Vega 1	Kern River
T. A. Webber	16	28 S.	27 E.	Webber 1	Kern River
Bergman Oil Co.	32	29 S.	22 E.	Peters Royalty Corp. 2	McKittrick
Bergman Oil Co.	30	30 S.	22 E.	1	McKittrick
Franco Western Oil Co.	8	30 S.	22 E.	12	McKittrick
Calcrude Petroleum Co.	34	30 S.	22 E.	4	Midway
Hugh B. Evans, Inc.	35	32 S.	23 E.	12	Midway
General Petroleum Corp.	24	31 S.	23 E.	Balboa 61	Midway
Ed McAdams	23	32 S.	23 E.	Ohio 1	Midway
Standard Oil Co.	3	32 S.	24 E.	65	Midway
Standard Oil Co.	33	32 S.	24 E.	218	Midway
Superior Oil Co.	6	32 S.	25 E.	Buena Vista Associates 1	Midway
Baker-Grover Co.	33	27 S.	28 E.	Baker 3	Mt. Poso
Ekoh Oil Co.	4	27 S.	28 E.	Ekoh-Vedder 2	Mt. Poso
General Petroleum Corp.	16	27 S.	28 E.	Heisen 15	Mt. Poso
General Petroleum Corp.	16	27 S.	28 E.	Heisen 16	Mt. Poso
General Petroleum Corp.	16	27 S.	28 E.	Heisen 17	Mt. Poso
Hugh L. Mann	27	26 S.	28 E.	Mann 2	Mt. Poso
Vincent F. Stabeck and C. J. Gardner	31	27 S.	28 E.	1	Mt. Poso
The Texas Co.	4	27 S.	28 E.	Alta Vedder 10	Mt. Poso
Vanguard Oil Co.	33	27 S.	28 E.	Baker 4	Mt. Poso
Vedder Petroleum Corp., Ltd.	3	27 S.	28 E.	Southern Pacific 1	Mt. Poso
Allied Petroleum Corp.	19	30 S.	29 E.	Allied 18	Mountain View
Hogan Petroleum Co.	29	30 S.	29 E.	Porter-Day 7	Mountain View
Hogan Petroleum Co.	32	30 S.	29 E.	Foster Comm. 2	Mountain View
Hogan Petroleum Co.	32	30 S.	29 E.	Foster Comm. 3	Mountain View
Hogan Petroleum Co.	32	30 S.	29 E.	Wharton 6	Mountain View
Hogan Petroleum Co.	5	31 S.	29 E.	Peters 1	Mountain View
Mohawk Petroleum Co.	30	30 S.	29 E.	Hood 9	Mountain View
North American Oil Cons.	5	31 S.	29 E.	Peters 1	Mountain View
The Ohio Oil Co.	33	30 S.	29 E.	Derby 4	Mountain View
Shell Oil Co.	32	30 S.	29 E.	Bahrenburg 3	Mountain View
Shell Oil Co.	32	30 S.	29 E.	Porter Two 7	Mountain View
Shell Oil Co.	32	30 S.	29 E.	Porter Two 8	Mountain View
Shell Oil Co.	32	30 S.	29 E.	Porter Two 9	Mountain View
Standard Oil Co.	13	30 S.	28 E.	Garcia 1	Mountain View
Standard Oil Co.	13	30 S.	28 E.	Warren 1	Mountain View
Standard Oil Co.	13	30 S.	28 E.	Wilson 3	Mountain View
Associated Oil Co.	4	28 S.	27 E.	Skinner 1	Poso Creek
Poso Petroleum Co.	2	27 S.	27 E.	1	Poso Creek
Standard Oil Co.	5	28 S.	27 E.	8	Poso Creek
Standard Oil Co.	5	28 S.	27 E.	9	Poso Creek
Standard Oil Co.	5	28 S.	27 E.	10	Poso Creek
Barnsdall Oil Co.	7	28 S.	29 E.	Caldwell 1	Round Mountain
Barnsdall Oil Co.	7	28 S.	29 E.	Caldwell 2	Round Mountain
Barnsdall Oil Co.	7	28 S.	29 E.	Caldwell 3	Round Mountain
Barnsdall Oil Co.	7	28 S.	29 E.	Caldwell 4	Round Mountain
California Western Oil Co., Ltd.	7	28 S.	29 E.	13	Round Mountain
California Western Oil Co., Ltd.	7	28 S.	29 E.	14	Round Mountain
California Western Oil Co., Ltd.	7	28 S.	29 E.	15	Round Mountain
California Western Oil Co., Ltd.	7	28 S.	29 E.	16	Round Mountain
California Western Oil Co., Ltd.	7	28 S.	29 E.	17	Round Mountain
Helm and Prewett	17	28 S.	29 E.	Olcese 1	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	88	Round Mountain
Honolulu Oil Corp., Ltd.	20	28 S.	29 E.	B	Round Mountain
Honolulu Oil Corp., Ltd.	20	28 S.	29 E.	C	Round Mountain
Round Mountain Oil Co.	19	28 S.	29 E.	Jewett 2	Round Mountain
Shell Oil Co.	7	28 S.	29 E.	Caldwell 3	Round Mountain
Shell Oil Co.	17	28 S.	29 E.	Olcese 15	Round Mountain
Alford Oil Co.	25	12 N.	24 W.	Fried 3	Sunset
Alford Oil Co.	25	12 N.	24 W.	Fried 4	Sunset
General Petroleum Corp.	6	11 N.	23 W.	Main Line 1	Sunset
General Petroleum Corp.	35	12 N.	24 W.	Moco 35 77	Sunset
Gibson Oil Co., Inc.	6	11 N.	23 W.	O'Brien 1	Sunset
Hallmark Oil Co., Inc.	25	12 N.	24 W.	4	Sunset
R. W. Jerman & Co.	32	12 N.	23 W.	Jerman 1	Sunset
Petroleum Drilling and Exploration Co., Inc.	25	12 N.	24 W.	2	Sunset
Richfield Oil Co.	36	12 N.	24 W.	Maricopa 10-A	Sunset
Richfield Oil Co.	36	12 N.	24 W.	Maricopa 11	Sunset
Standard Oil Co.	36	12 N.	24 W.	M. J. M. & M. 63	Sunset
Standard Oil Co.	36	12 N.	24 W.	M. J. M. & M. 64	Sunset
Standard Oil Co.	36	12 N.	24 W.	M. J. M. & M. 65	Sunset

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued					
Calcoast Oil Co.	36	26 S.	27 E.	Calcoast 1	
The Ohio Oil Co.	1	30 S.	25 E.	K. C. L. D-1	
The Ohio Oil Co.	31	31 S.	26 E.	Kern County Land Co. A-5	
The Ohio Oil Co.	32	31 S.	26 E.	Kern County Land Co. A-6	
Reserve Oil and Gas Co.	2	10 N.	19 W.	Tejon Ranch 5	
Shell Oil Co.	29	30 S.	26 E.	K. C. L.-Stevens A-1	
KINGS COUNTY:					
Kettleman North Dome Assoc.	34	21 S.	17 E.	41	Kettleman North Dome
Kettleman North Dome Assoc.	34	21 S.	17 E.	74	Kettleman North Dome
LOS ANGELES COUNTY:					
Shell Oil Co.	33	3 S.	13 W.	Reyes 83	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 69	Dominguez
Union Oil Co.	28	3 S.	13 W.	Callender 46	Dominguez
Union Oil Co.	33	3 S.	13 W.	Callender 44	Dominguez
Union Oil Co.	33	3 S.	13 W.	Callender 45	Dominguez
Union Oil Co.	33	3 S.	13 W.	Carson 8	Dominguez
Union Oil Co.	33	3 S.	13 W.	Hellman 42	Dominguez
Standard Oil Co.	8	2 S.	14 W.	Cone 18	Inglewood
Standard Oil Co.	8	2 S.	14 W.	Vickers I 35	Inglewood
Cone Oil Co.	20	3 S.	14 W.	Peck 10	Lawndale
D. W. Elliott, Inc.	30	4 S.	12 W.	1	Long Beach
Keystone Western Oil Co.	29	4 S.	12 W.	2	Long Beach
Shell Oil Co.	29	4 S.	12 W.	Cherry Hill Comm. 12	Long Beach
Shell Oil Co.	29	4 S.	12 W.	Pickler 12	Long Beach
Richfield Oil Co.	5	2 S.	11 W.	Ciocca 1	Montebello
Richfield Oil Co.	5	2 S.	11 W.	Nutt 1	Montebello
The St. Helens Petroleum Co., Ltd.	6	2 S.	11 W.	Piuma-Briano 7	Montebello
Standard Oil Co.	1	2 S.	12 W.	Baldwin 80	Montebello
Standard Oil Co.	1	2 S.	12 W.	Baldwin 83	Montebello
Standard Oil Co.	1	2 S.	12 W.	Baldwin 84	Montebello
Universal Consolidated Oil Co.	6	2 S.	11 W.	P 1	Montebello
Eastern Oil Co.	22	2 S.	15 W.	Eastern 1	Playa del Rey
Herndon Development Co., Ltd.	27	2 S.	15 W.	Herndon Development 29-2	Playa del Rey
The Ohio Oil Co.	22	2 S.	15 W.	Recreation Gun Club 18	Playa del Rey
Royalty Service Corp., Ltd.	27	2 S.	15 W.	F-1	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	Del Rey 13	Playa del Rey
Mars Oil Co.	20	3 S.	13 W.	Mars 1	Rosecrans
General Petroleum Corp.	5	3 S.	11 W.	Santa Fe 137-F	Santa Fe Springs
Union Oil Co.	31	2 S.	11 W.	Bell 92	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Alexander 32	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 93	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 96	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 97	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 99	Santa Fe Springs
Associated Oil Co.	11	5 S.	12 W.	Hellman 18	Seal Beach
Continental Oil Co.	3	5 S.	12 W.	Bixby 38	Seal Beach
Standard Oil Co.	3	5 S.	12 W.	San Gabriel 27	Seal Beach
B. and N. Oil Co.	17	4 S.	14 W.	Huntington Redondo 1	Torrance
Dumas-Lewis Oil Co.	6	4 S.	14 W.	Dumas-Lewis 1	Torrance
Otis Hoyt	6	4 S.	14 W.	Redondo 1	Torrance
Rennek Oil & Gas Corp.	5	4 S.	14 W.	1	Torrance
Tu Jax Oil Co.	32	3 S.	14 W.	1	Torrance
White Five Oil Co.	31	3 S.	14 W.	1	Torrance
Harbor Drilling Corp.	33	4 S.	13 W.	1	
North American Oil Consolidated	5	2 S.	11 W.	Glass 1	
Republic Petroleum Co., Ltd.	18	3 S.	14 W.	Republic El Segundo 2	
Sovereign Oil Corp.	28	4 S.	13 W.	Banning 1	
Womac, Inc.	4	2 S.	11 W.	Womac 1	
ORANGE COUNTY:					
Continental Oil Co.	21	3 S.	9 W.	Carlton Comm. 1	Coyote Hills
Standard Oil Co.	18	3 S.	10 W.	Murphy-Coyote 126	Coyote Hills
W. K. Co.	35	5 S.	11 W.	W. K. 7	Huntington Beach
Union Oil Co.	29	3 S.	9 W.	Chapman 29	Richfield
Hillman-Long, Inc.	14	5 S.	11 W.	Westminster 1	
RIVERSIDE COUNTY:					
Fred E. Stevens	27	3 S.	7 W.	Everett 1	

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
SAN JOAQUIN COUNTY:					
Amerada Petroleum Corp.	15	2 S.	5 E.	F. D. L. 4	
Amerada Petroleum Corp.	15	2 S.	5 E.	F. D. L. 5	
Standard Oil Co.		2 N.	4 E.	McDonald Island Farms 1	
SAN LUIS OBISPO COUNTY:					
Pismo Petroleum Corp.	5	32 S.	13 E.	Scott 1	Arroyo Grande
SANTA BARBARA COUNTY:					
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 1 12	Capitan
Shell Oil Co.	32	5 N.	30 W.	Orella 3	Capitan
Signal Oil and Gas Co.	16	4 N.	29 W.	Appleford 98 7	Elwood
Anacapa Oil Corp.	28	4 N.	27 W.	Low 4	Mesa
Union Oil Co.	26	9 N.	34 W.	Calif. Coast 16	Santa Maria
Union Oil Co.		5 N.	35 W.	Sudden 1	
Union Oil Co.	24	10 N.	34 W.	Adams 1	
TULARE COUNTY:					
Kenwood Petroleum Corp.	14	24 S.	27 E.	Kenwood 1	
Standard Oil Co.	34	24 S.	23 E.	Tulare Farms 1	
VENTURA COUNTY:					
Petroleum Securities Co.	3	3 N.	19 W.	Home Ranch 3	Bardsdale
The Texas Co.	4	3 N.	19 W.	Shiells 129	Bardsdale
Bolsa Chica Oil Corp.	4	4 N.	18 W.	Snow 3	Piru
The R. P. Johnson Corp.	21	4 N.	18 W.	Rubel 1	Piru
Honolulu Oil Corp., Ltd.	7	3 N.	24 W.	56-3	Rincon
Neil C. Needham	7	3 N.	24 W.	Needham 4	Rincon
Rincon Oil Co.	7	3 N.	24 W.	Shudde 3	Rincon
Calco Petroleum Corp.	17	3 N.	20 W.	Schieferle 3	South Mountain
Associated Oil Co.	23	3 N.	23 W.	Lloyd 98	Ventura
Associated Oil Co.	23	3 N.	23 W.	McGonigle 12	Ventura
Associated Oil Co.	27	3 N.	23 W.	Lloyd 99	Ventura
General Petroleum Corp.	26	2 N.	23 W.	McGrath 2	

SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

GEOLOGY, MINING AND PROCESSING OF DIATOMITE AT LOMPOC, SANTA BARBARA COUNTY, CALIFORNIA

By Henry Mulryan[a] [b]

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ABSTRACT

The largest and purest known deposit of diatomite is being actively mined and processed three and one-half miles south of Lompoc, Santa Barbara County, California by the Johns-Manville Corporation.

The workings cover 4000 acres, the depth of economically recoverable diatomite being 1000 feet.

These marine beds assigned to the Monterey formation, Upper Miocene are generally soft, white, extremely porous, light weight, and of remarkable uniformity and purity.

The diatomite is quarried on the surface by gasoline and diesel-powered shovels, and loaded into trucks which haul the material to vertical storage shafts sunk in the diatomite. The diatomite is drawn off at the bottoms of the holes into cars and hauled underground by electric trolley locomotive to the primary crushing plant.

The crushed crude is conveyed to mill bins and processed. Powders for filtration, admixtures, mineral fillers, and insulation purposes are produced in the milling systems.

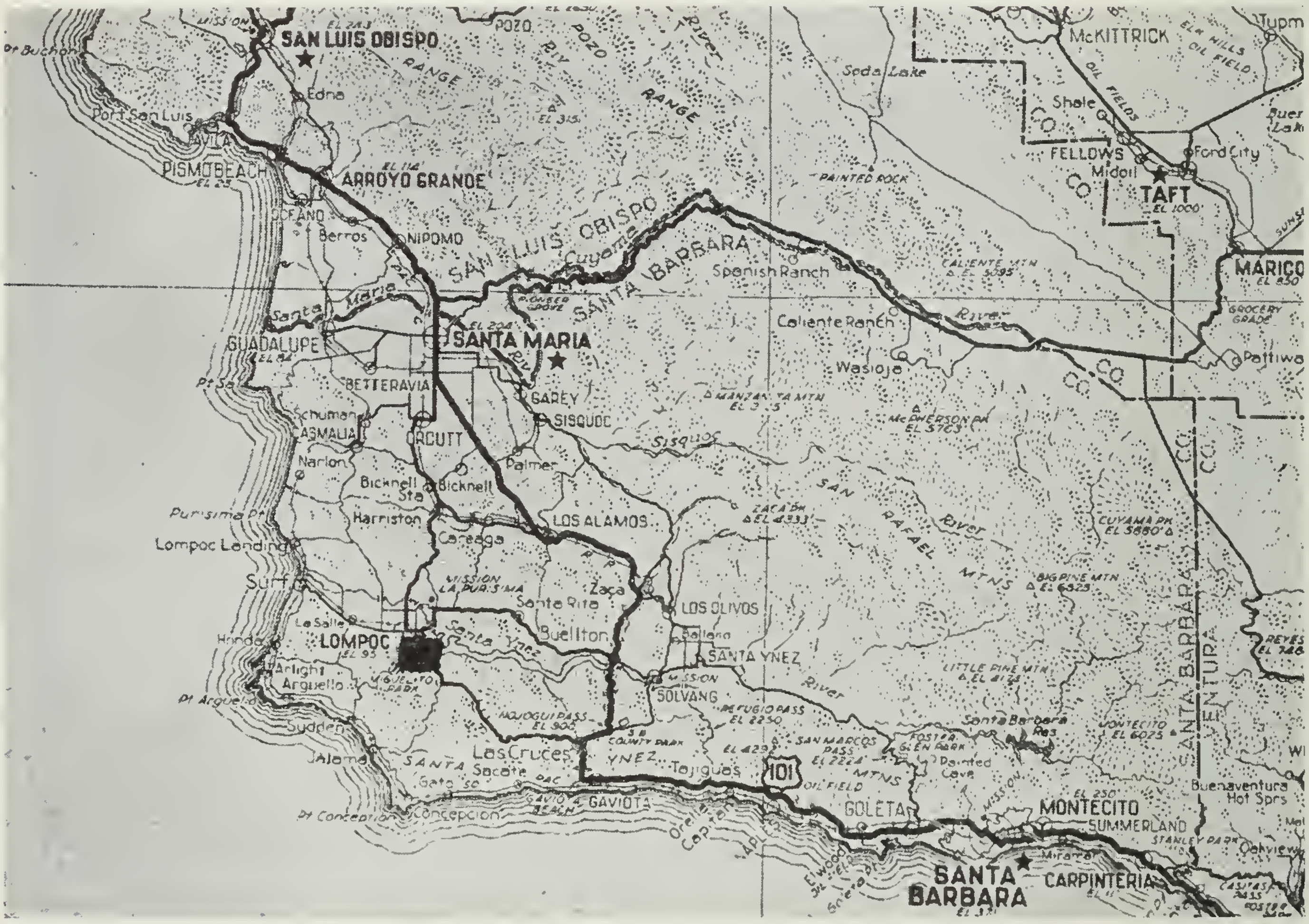
---

[a] Geologist, Johns-Manville Products Corp., Lompoc, Cal.

[b] Presented at Regional Meeting, American Institute of Mining and Metallurgical Engineers, San Francisco, October 3-4, 1935.

Insulation brick are sawn directly in the quarries or produced from aggregates and calcined in a tunnel or beehive kiln.

The company maintains a complete machine shop, garage, electric and carpenter shops, camp for employees, hospital and a plant development department, at the deposit. A research staff is established at Manville, New Jersey.


SAN LUIS OBISPO
ARROYO GRANDE
SANTA MARIA
LOMPOC
SANTA BARBARA
MONTECITO
GOLETA
TAFT
GUADALUPE
ORCUTT
LOS ALAMOS
SOLVANG
SANTA YNEZ
LOS OLIVOS
Buellton
Surf
GAVIOTA
CARPINTERIA
McKITTRICK

Index map, showing location of Lompoc in southwestern Santa Barbara County.

Location of the Deposit

The deposit of diatomite that is being mined and processed by the Johns-Manville Products Corporation, is located three and one-half miles south of the city of Lompoc, a community of 2500 population, situated in the Santa Ynez River Valley ten miles inland from the Pacific Ocean. It is forty-four miles westerly from Santa Barbara, and fourteen miles north of Point Conception. A branch line of the Southern Pacific Company connects Lompoc with the main Coast Route at Surf, ten miles west, and continues southward from the city to the deposit, processing plants and warehouses of the company.

History

The first records of production of diatomite at Lompoc show that the Spanne Brothers in the late 1880's removed large blocks of diatomite, hauled them to Lompoc, sawed them with a table saw into rectangular blocks of varying sizes. The blocks were used for the erection of a two-story building having walls nearly one foot thick.

In 1892, A. G. and J. F. Balaam hand-quarried lumps, piled them in rows for natural air drying, and sacked the material for shipment to Captain Barrow in San Francisco. He experimented with the diatomite mixed with tule fiber and produced a fair grade of covering for pipe insulation.

The first building, a shed to cover previously air-dried diatomite, was erected by the Balaams at the Balaam quarry in 1896.

In 1894 a large block was exhibited at the Midwinter Fair in San Francisco. The exhibit created considerable comment and interest due to its light weight, color, and other physical characteristics.

In 1898 one ton of diatomite was shipped to the California Anti-Caloric Company in San Francisco. They were experimenting along insulation lines.

In 1902 Harriman & Hanimore came into control of the Dimock Mine near the Balaam property. They hand-quarried, piled and air dried, and shipped crude material to the California Silica Company in Los Angeles.

In 1904 the Magne Silica Company was incorporated by Harriman & Hanimore to operate the Dimock Mine. They operated under severe financial handicaps for the next four years. In 1904 crude diatomite from the Balaam Mine was being used as boiler and pipe insulation, as furnace lining, in beet sugar filtration and in the manufacture of a fireproof plaster at the Fireproof Plaster Works, Emeryville, California.

PHOTO No. 1. The first building erected at the Celite Deposit. Built in 1896.

In 1906 the Magne Silica Company erected in Lompoc a simple pulverizing mill for the purpose of reducing the crude lumps to powder.

In 1908 Robert Graham gained control of the operating properties. He was the first person to institute the system of cutting bricks directly from blocks in the quarries. In 1909 the Magne Silica Company regained the business which continued under its management until 1912.

In 1912 Fitger & Anneke, brewers in Duluth, Minnesota, purchased the property, changing the name to the Kieselguhr Company of America. They built milling equipment in Lompoc, and later drying and milling equipment at the deposit. Under their ownership a strong effort was made toward the using of diatomite in the filtration of sugar.

During the World War the German word 'kieselguhr' became unpopular. A new name, Celite, was coined for the diatomite and diatomite products produced at this White Hills deposit. The company was renamed the Celite Products Company, the mine and plant being known as the Celite Company. In 1926 the Celite Company acquired the interests of the Featherstone Company who were leasing the adjoining acreage on the Hollister Estate.

In 1928 the Celite Company was sold to the Johns-Manville Corporation. The name was changed to the Celite Corporation and later to the Lompoc Factory of the Johns-Manville Products Corporation.

Acknowledgments

Nearly all of the information contained in this report is a compilation of data from the author's intimate contact with the geological, mining, milling, and research phases of the diatomite operations at Lompoc while employed by the Celite Company and the Johns-Manville Products Corporation.

For a considerable portion of the historical sketch he is indebted to A. G. Balaam of Lompoc. Further information regarding the early period was derived from Bulletin 38, "The Structural and Industrial Materials of California," California State Mining Bureau, 1906.

Acknowledgments are also due to Messrs. A. Cromwell, W. B. Kelley, A. S. Elsenbast and Dr. A. B. Cummins, of the Johns-Manville Corporation, for their interest and cooperation.

Topography

The Santa Ynez mountains consist of a long narrow east-west range bounded on the north by Santa Ynez River and on the south by Santa Barbara Channel. In this area there are rounded hills averaging slightly more than 1200 feet in elevation.

North of the main high ridge are the low rolling Lompoc Hills in which the diatomite is contained. These are characterized by numerous canyons, all with exceptionally steep walls, but whose bottoms appear to be filled to such a point that they are well rounded. Narrow secondary water courses may be in the center, or on either side of the canyon, or may be missing entirely. The hill tops are generally well rounded, or often even flat topped.

The canyons are directly due to structural conditions rather than erosional factors, and usually follow the weakened zones in the vicinity of the axes of anticlines or along fault planes.

The high features are invariably in the synclines where compression forces have caused strengthening of the soft diatomite beds.

Geology

General Statement:

The formations exposed in this area are mainly sedimentary rocks which include Cretaceous, Eocene, Miocene, Pliocene, and Quaternary.

The oldest rocks exposed are serpentines generally assigned to the Franciscan (Jurassic?), but the writer is of the opinion that more detailed work on the exposures at the head of La Salle Canyon (Stewart's Grade) should be done prior to a definite assignment to any given age.

Recent examinations of San Pasqual Canyon have revealed a thick series of shales and sandstones that may be Eocene or even Cretaceous in age.

Limestone, limy conglomerate, and soft sandstone of Vaqueros age are exposed in San Miguelito Canyon. Lying above, conformably, are the siliceous shales of the Monterey, attaining a thickness of more than 5000 ft. The hard, thinly laminated shales lie below, the soft diatomite beds, above. The average thickness of the soft beds is 1000 ft. Below this thousand feet are interbedded soft diatomites and opalized hard shales attaining a thickness of slightly less than 1000 ft.

Near the top of the soft diatomite beds is a thin bed of conglomerate which may be considered a transition zone between the upper Miocene and the Fernando. Fernando sands are exposed north, east and west of Lompoc, but not in the area being actively mined for diatomite.

Quaternary sediments fill the valleys.

Pre-Monterey Rocks:

Serpentine

An exposure of serpentine covers about three square miles from La Salle to San Pasqual canyons. It is an igenous rock that shows a fair degree of alteration which produced a slight amount of asbestos. In general, it is not the bluish-green shiny rock that usually characterizes California Coast Range serpentines, but shows less alteration. It is generally assumed to be of Franciscan age, but the writer is of the opinion that more detailed work on the exposures and contacts should be done prior to a definite assignment to this age.

Sediments

Above the serpentine is a considerable thickness of sedimentary rocks variously assigned to the Cretaceous, Eocene, Oligocene and Lower Miocene. Here are sandstones, bituminous shales, carbonaceous shales, limy conglomerates and limestone. These rocks are described by Arnold and Anderson in Bulletin 322, "Geology and Oil Resources of the Santa Maria District." U. S. Geol. Survey 1907.

Monterey Rocks:

The Monterey series is of chief interest in this region because it contains the soft diatomite beds.

The entire series is slightly more than 5000 ft. thick. The lowest part is composed of hard, siliceous shales, thickly bedded, and showing considerable leaching effect, probably calcareous material having been removed. These beds are badly contorted by sharp folding.

Above these strata are the typical Monterey hard, siliceous, thin-banded shales that are found so abundantly in the coast ranges. They are light-brown to chocolate-colored. The thickness of these beds is about 1500 ft. Conformable to these are interbedded impure but well

Photo No. 2. Aerial view of the deposit, looking easterly.

stratified soft diatomites and hard, glassy, opalized siliceous shales. The diatomite varies in color from white on the outcrop to greenish-black when under a thick cover of overburden. The opalized shales are usually black, but translucent in thin fragments. This series is about 1000 ft. thick.

Lying directly above are beds of diatomite of varying degrees of purity that are 1000 ft. thick. These are all white on the outcrops. At the top of the diatomite series are two sandy conglomerates each one foot thick and separated by about five feet of clayey diatomite The conglomerate marks the top of the diatomite series in the areas under discussion. It consists of well-rounded Monterey shales, tuffaceous rocks, and sandstones. Shark bones and teeth are fairly common; shells have not been found.

Fernando:

The Fernando sands and sandstones are not important in the diatomite deposit. They are discussed in detail in the bulletin cited before.

Structural Features:

The Lompoc Hills contain gently folded synclines and anticlines. The main deposit of diatomite lies in a broad syncline one and one-half miles wide and two and one-half miles long. Toward the south is a series of smaller anticlines and synclines that have little of the soft diatomite contained in them. It has either been eroded away or was never deposited. The more-siliceous hard shales predominate.

Northward is a narrow anticline, a syncline of similar width, and a broad anticline about half as wide as the main syncline. The following synclines and anticlines contain less thickness of soft beds and show changing conditions of deposition. The beds are usually thinner northward from the main syncline.

All of the present workings are confined to the main syncline, both limbs, the first narrow anticline northward, and the next broad anticline northward. The general strike is N. 65° E. The strike changes easterly rapidly near the eastern end. The dips are usually gentle, the maximum being 50° near the bottom of the syncline. As the beds approach the bottom of the syncline the dip flattens to a well rounded basin at the axis.

Faulting:

Faulting is unimportant in the main deposit. There is one fault striking nearly west that affects the strike of the beds in the south limb of the syncline only. The displacement has been mostly horizontal with only a slight vertical displacement.

Two major faults are found at the northeast and southwest ends of the property. On the southwest end a cross fault has lifted the west block upward causing the erosion of the soft beds, the only rocks exposed being the formerly underlying hard siliceous shales. On the northeast another cross fault following Salsipuedes Creek has caused horizontal and some vertical displacement.

These two faults coupled with the thinning of the strata northward and eastward have confined the best beds of usable diatomite to the region controlled by the Johns-Manville Corporation. One major fault

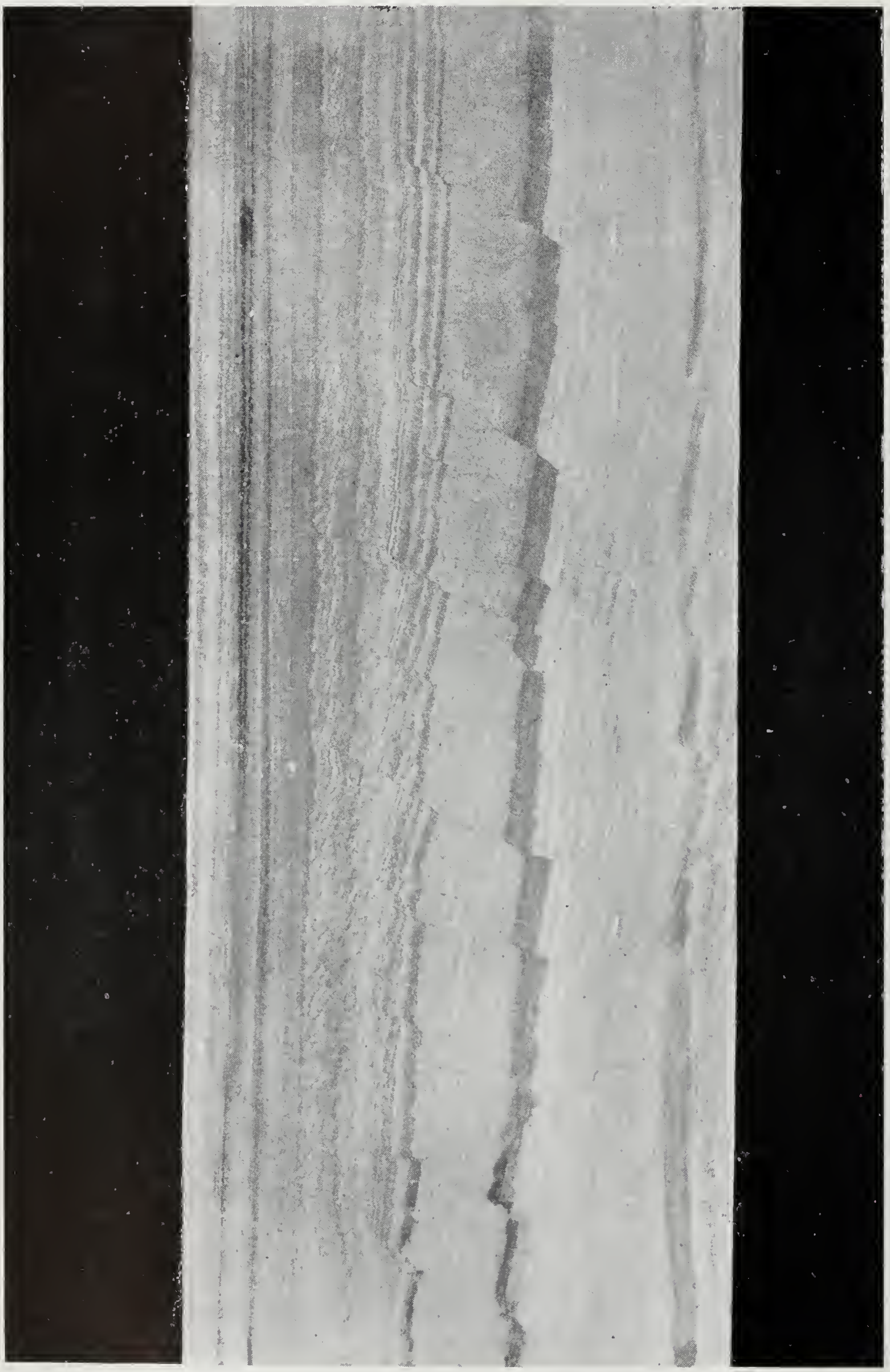


PHOTO NO. 3. Natural brick sawed from the Brick Quarry. Shows minute faulting. The brick is natural size.

in the second anticline northward roughly parallels the axis causing a difference in elevation of more than 350 feet. The south side of the canyon is that much higher than the beds on the north side.

What might be termed microscopic faulting has taken place in the diatomite itself. In natural brick are often found many parallel faults showing vertical displacements of less than 1/64 of an inch. (See Photo No. 3.)

As stated before, faulting does not affect the quarrying nor underground workings. It merely serves to confine the best diatomite to the various folds where it can easily be recovered by open quarry or underground mining methods.

Diatomite Deposit

General Statement:

The company owns or controls an area comprising 4000 acres in the main deposit. The diatomite contained therein is remarkable because of the high degree of purity in this huge deposit. It is generally accepted as the largest and purest known deposit in the world. Its great thickness, more than 1000 ft., and its undisturbed condition, with the added benefit of sufficient relief to permit easy mining conditions, certainly place the deposit in a unique position.

Deposition:

How did such a great thickness of diatomite occur?

We know that diatoms are microscopic, single-celled plants that have a siliceous skeleton. The marine types prefer clean salt water as their habitat, and thrive best where the water contains sufficient silica for the building up of their highly ornate skeletons.

The upper Miocene is accepted as one of considerable volcanic as well as submarine igneous activity. In the course of such eruptions great quantities of silica—probably as silicic acid in the submarine activity and as slightly soluble siliceous minerals in the land activity—made its way into the ocean.

Interstratified in the diatomites are thin beds of pure volcanic ash whose chemical composition places it as rhyolite in nature. Scattered throughout the entire beds are grains of volcanic ash, which probably have been transported a considerable distance. However, here is another source of silica for the diatoms.

The beds are remarkably free of material coarser than fine silt.

A so-called impure heavy stratum may contain as its only impurity, clayey material and that seldom in excess of 10% alumina. Pebbles are occasionally found, but they have always occurred surrounded by excrement, indicating that they were transported there by a bird or fish of some sort. The diatomite surrounding a pebble has a depression at the bottom, and at the top the stratification conforms to the pebble's shape for probably an inch or less, when it resumes its horizontal plane again.

The question naturally arises as to how such great deposits of diatomite were formed. Some writers refer to the area as probably one of aridity, bays of small extent or an archipelago of small islands.[1]

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[1] "Fossil Fishes of the (Miocene) Monterey Formations of Southern California." D. S. Jordan and J. Z. Gilbert, Stanford University publications 1919, p. 13.

Dr. Frank M. Anderson is quoted in the same article, p. 14:

> "I believe that the diatoms, or the marine species of the Monterey group, are or were northern forms, and lived in the cooler waters of the north Pacific of the Miocene, and were brought south by the ocean currents of the time, and were trapped and impounded in such favorable places as were found along the Pacific Coast of the period. Such favorable places were local and more or less land-locked, or protected areas of sea, free from sedimentation from the land, and where the surface waters of the sea were free to enter and escape, but where they were detained long enough to lose their contents of northern forms under conditions of temperature too high to permit their survival. It appears to me that the deposits of diatomaceous strata, as they are known in California, are all more or less local, and in their occurrence and distribution, conform to this idea."

G. D. Hanna and W. M. Grant[2] found that Miocene diatoms are found as far south as Maria Madre Island, Mexico. They state:

> "The diatomite is believed to be Miocene in age. Many of the diatoms belong to species which have previously been found only in Monterey shale of California."

If the diatoms are North Pacific forms they have covered many degrees of latitude southward, as the Tres Marias Islands lie at latitude 21 north off the coast of Mexico due west of San Blas.

The diatoms found in the purest beds show little if any abrasion, and have all the indications of having lived in the near vicinity.

Assuming that most of the fish described by Dr. Jordan are shallow-water forms we can readily ascribe to Dr. Anderson's views that the region was one of protected areas of the seas. However, in view of the absence of detrital material any nearby land masses should have little or no relief.

The same results of deposition could be obtained by the diatoms living, propagating, dying, and dropping to the ocean floor in an open sea, facing on a shore line of little relief, such as the east coast of Florida. The same deposition could also take place in sea water far enough away from a land mass of high relief to be free from the effects of erosion. The shallow-water fossil fish would preclude deep water conditions of deposition.

It is the author's opinion that the deposit was formed from diatoms which propagated nearby in shallow water in protected areas of the sea where the land had little or no relief.

Effect of Seasonal Rainfall:

An interesting feature of the thinly stratified beds is the succession of extremely thin nearly pure strata and likewise thin but slightly 'clayey' strata. In all thinly laminated diatomites these strata are noticeable at once by the slightly darker color of the 'clayey' strata over the nearly pure diatom strata. The effects of rainfall, erosion, amount of microscopic silt in the water at various seasons, all can be seen in a given specimen.

On a larger scale we can take a series of the thinly laminated beds, say 20 ft. thick, underlain by one 4 feet thick that is only poorly laminated, is darker colored, whose particle size is very much greater, and which is definitely higher in clay or silt content. Underlying this may be a series of 40 ft. or more of poorly stratified material which usually ends with what is called a 'solid clay' band 1 to 6 inches thick. Immediately below are found more of the thinly laminated beds.

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[2] "Expedition to the Revillagigedo Islands, Mexico, in 1925, II," Proc. of the California Academy of Sciences, Vol. XV, No. 2, p. 116, 1926.

The relationships of these pure and impure beds as well as those of the tiny interlaminations with seasonal rainfall and erosion is a problem that will receive further study.

Diatomite:

The diatomite in the 1000-ft. section can be classed into three kinds, (1) pure thinly stratified, (2) impure conchoidally fracturing and (3) impure clayey coarsely stratified. These are in their order of economic importance.

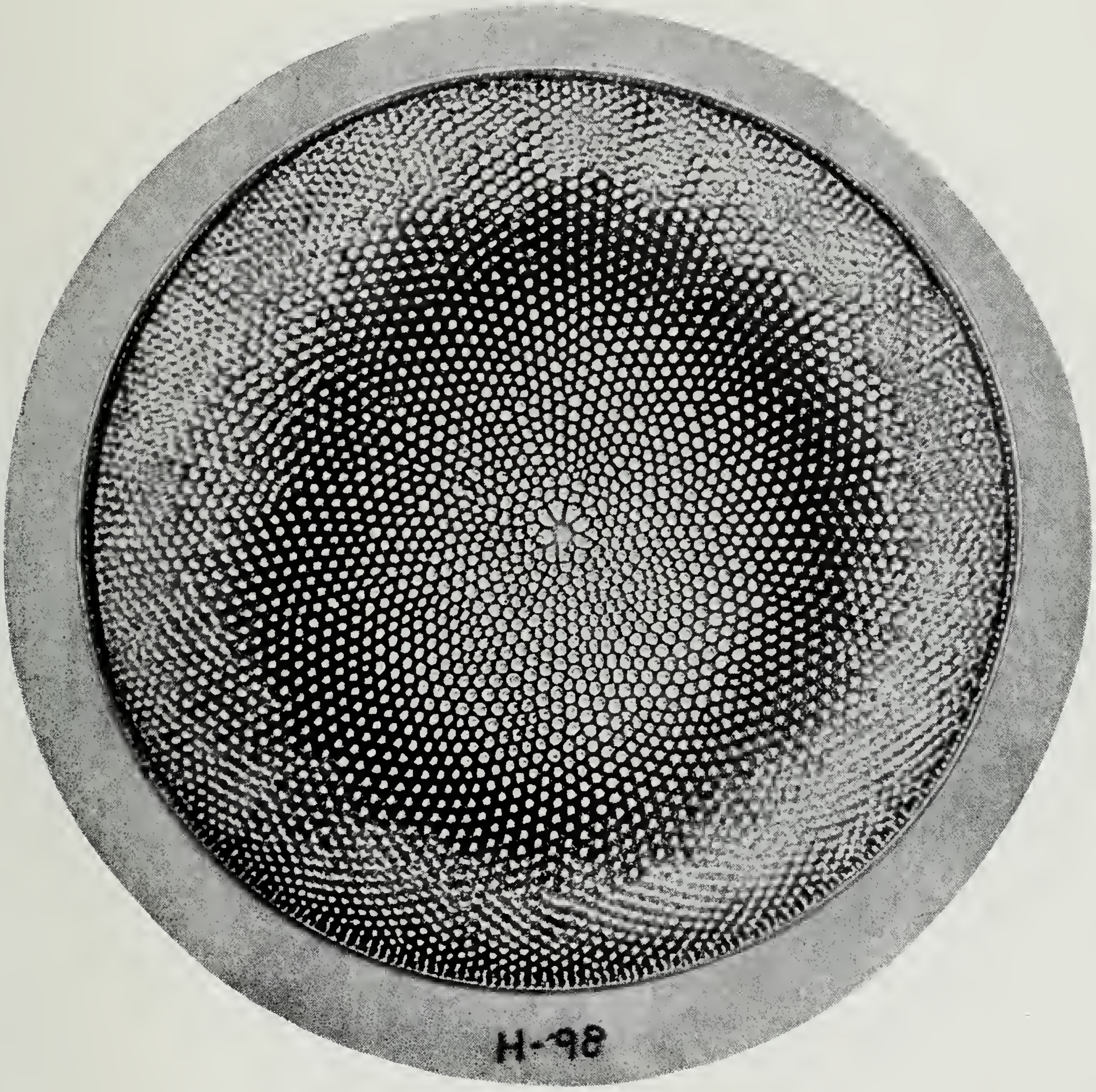

PHOTO NO. 4. Coscinodiscus. Magnification 700X.

To understand properly their stratigraphic relationships it is necessary to mention that the thin conglomerate and coarse-sand conglomerate are at the top. Below this lies the impure unstratified conchoidally fracturing diatomite. Under this bed are alternating pure thinly stratified beds and the impure clayey but coarsely stratified beds.

(1) The most important beds economically are those that are thinly stratified. This diatomite is white, soft, porous, and strong. A natural brick 2½ inches thick, 4½ inches wide, and 9 inches long will stand pressures of over 100 pounds per square inch when applied at right angles to the stratification. Stratification lines vary in thickness

from a hair line to $\frac{1}{4}$ inch, the average being about $\frac{1}{32}$ inch. Some are nearly microscopic in thickness.

The diatomite in the bank is always slightly gray or even light brown, but when dried thoroughly it assumes a nearly white color. The presence of moisture makes coloring matter more noticeable. On the surface the diatomite is always lighter colored than underground.

The difference in color in the upper zones is due to oxidation and removal by leaching of the impurities and extremely fine diatomaceous material.

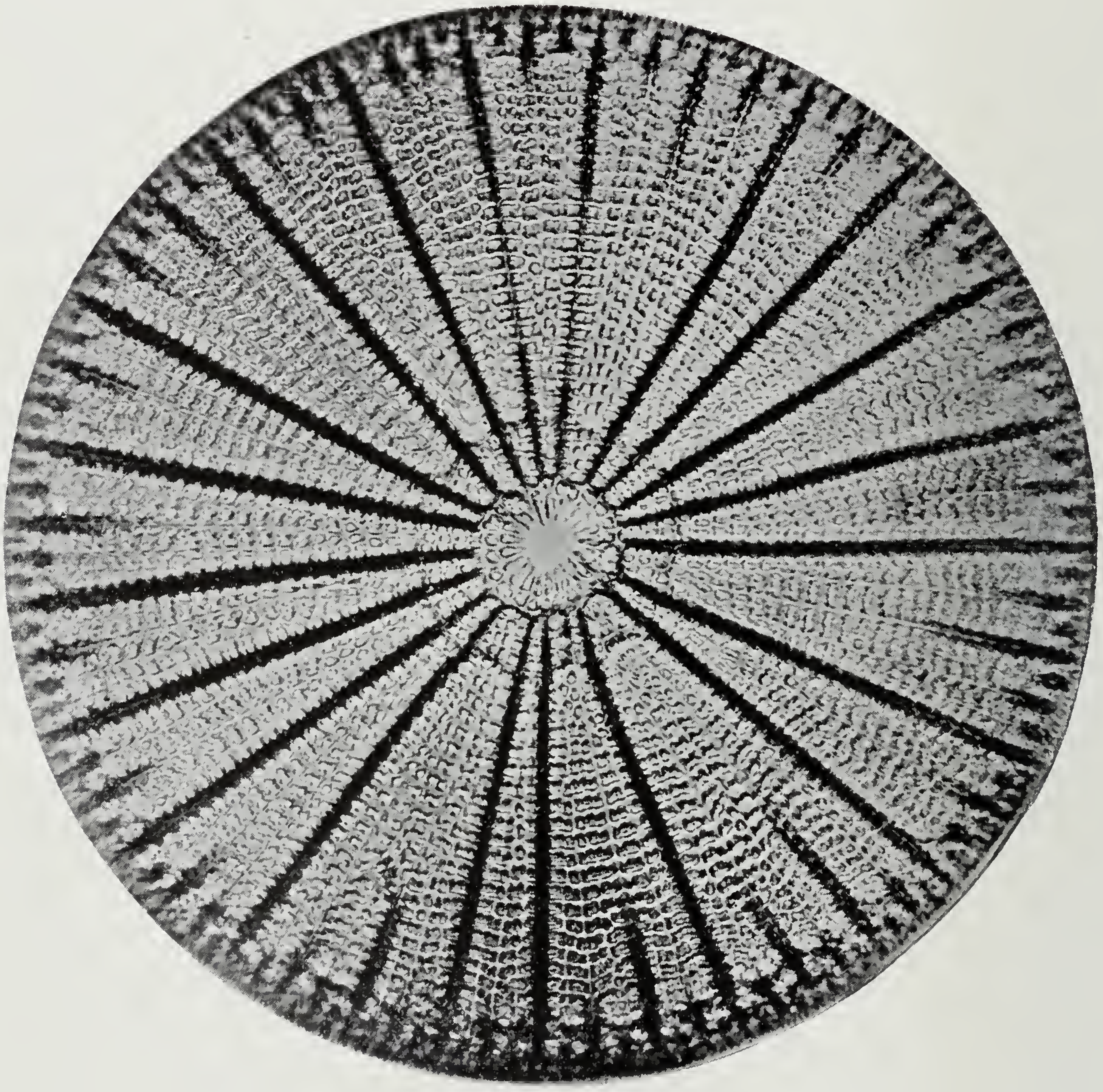

PHOTO NO. 5. Arachnoidiscus. Magnification 720X.

The diatomite in place is always moist.

The more porous beds may contain a minimum of 20% water; the less porous, 30% at the surface. A few feet below the surface these percentages increase rapidly to more than 50% at the main-tunnel level which is well above the free-water level. When saturated the diatomite contains slightly less than 75% moisture.

It is interesting to note that though during winter months the surface rocks contain more moisture than in summer, that shortly below the surface the diatomite carries a constant percentage.

Capillary attraction plays an important part in this constant moisture content, and also explains the presence of efflorescent soluble salts on some outcrops of diatomite. Continual drawing up of water from below also brings soluble salts to the surface where evaporation takes place with consequent deposition of the salts there. This is particularly true on the outcrops of less pure beds of diatomite. The zone where this evaporation and concentration of salts is effected is very narrow, only a few feet deep.

Some efflorescences also occur in tunnels that have been opened for long periods of time; the concentration being greatest on the least pure beds. Efflorescences always occur in underground workings that expose greenish-colored diatomites.

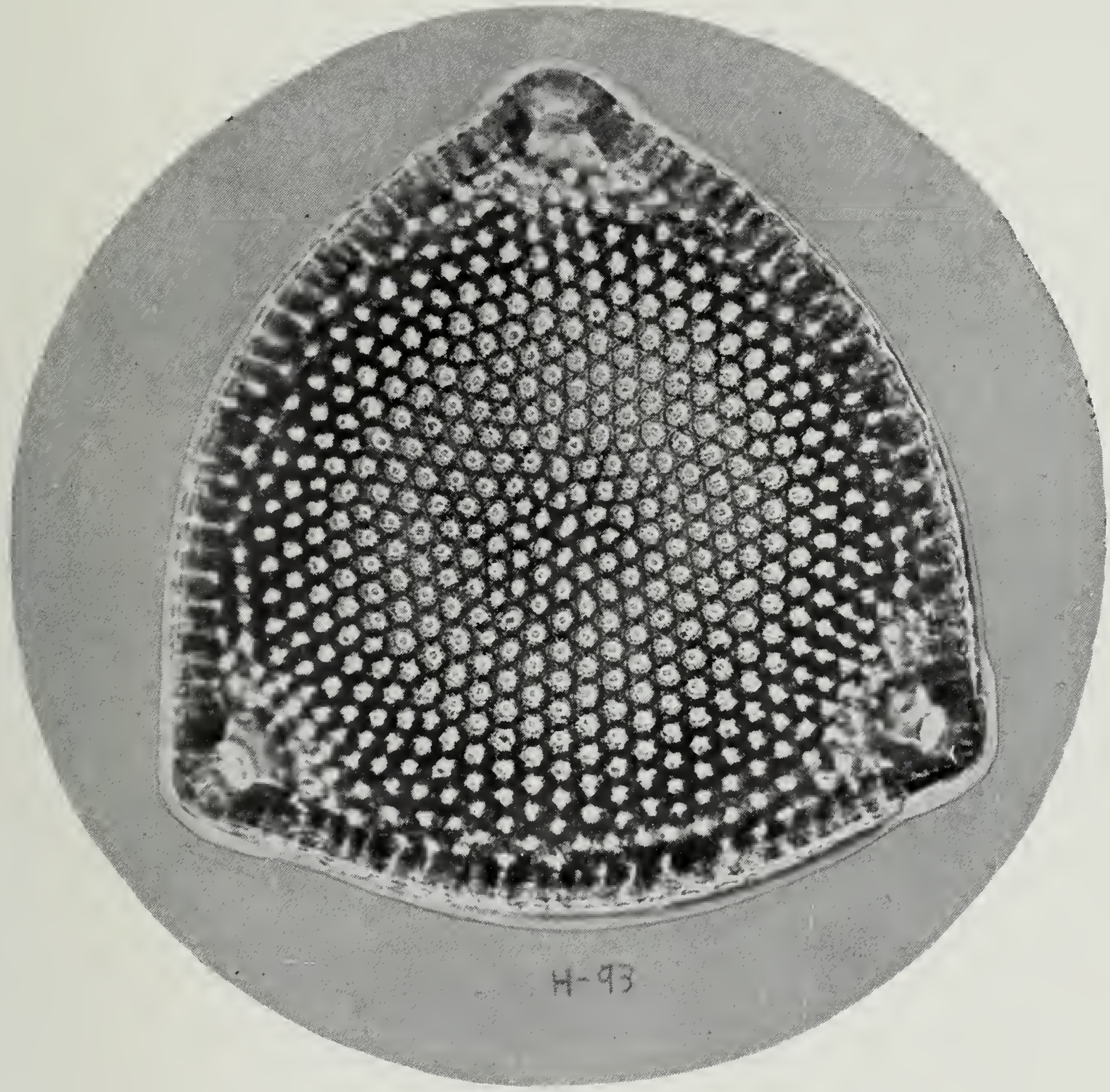

PHOTO No. 6. Biddulphia. Magnification 1000X.

The thinly stratified beds to the 500-foot level can be considered as white color. They are the purest beds, not only in silica content, but also in diatom structure. Chemical compounds other than organic are few, and make up only a minor amount of the total.

Celite is composed principally of a mixture of different-size filaform or needle-shaped diatoms, disc-shaped diatoms and fragments of each. The filaform or spicular-shaped diatoms are mainly *Synedra, Thallasiothrix, Thallasionema* and *Nitzschia.* The disc diatoms are principally *Coscinodiscus*, *Arachnoidiscus*, *Actinoptychus*, *Aulacodiscus*, *Auliscus* and *Asterolampra* of which *Coscinodiscus* is the more prevalent discoid form.

The percentage of filaform to disc shapes varies considerably throughout the deposit. Some strata contain as low as 15% or 20% filaform shapes whereas other strata may run as high as 75% or even 85% filaform types.

Over two hundred other varieties of diatoms have been noted as accessory forms in Celite. The organisms other than diatoms are silicoflagellates, radiolaria and sponge spicules. No foraminifera have been observed in the deposit. Some of the accessory forms of diatoms include *Navicula*, *Biddulphia*, *Dicladia*, *Xanthiopyxis* and *Rauxia*.

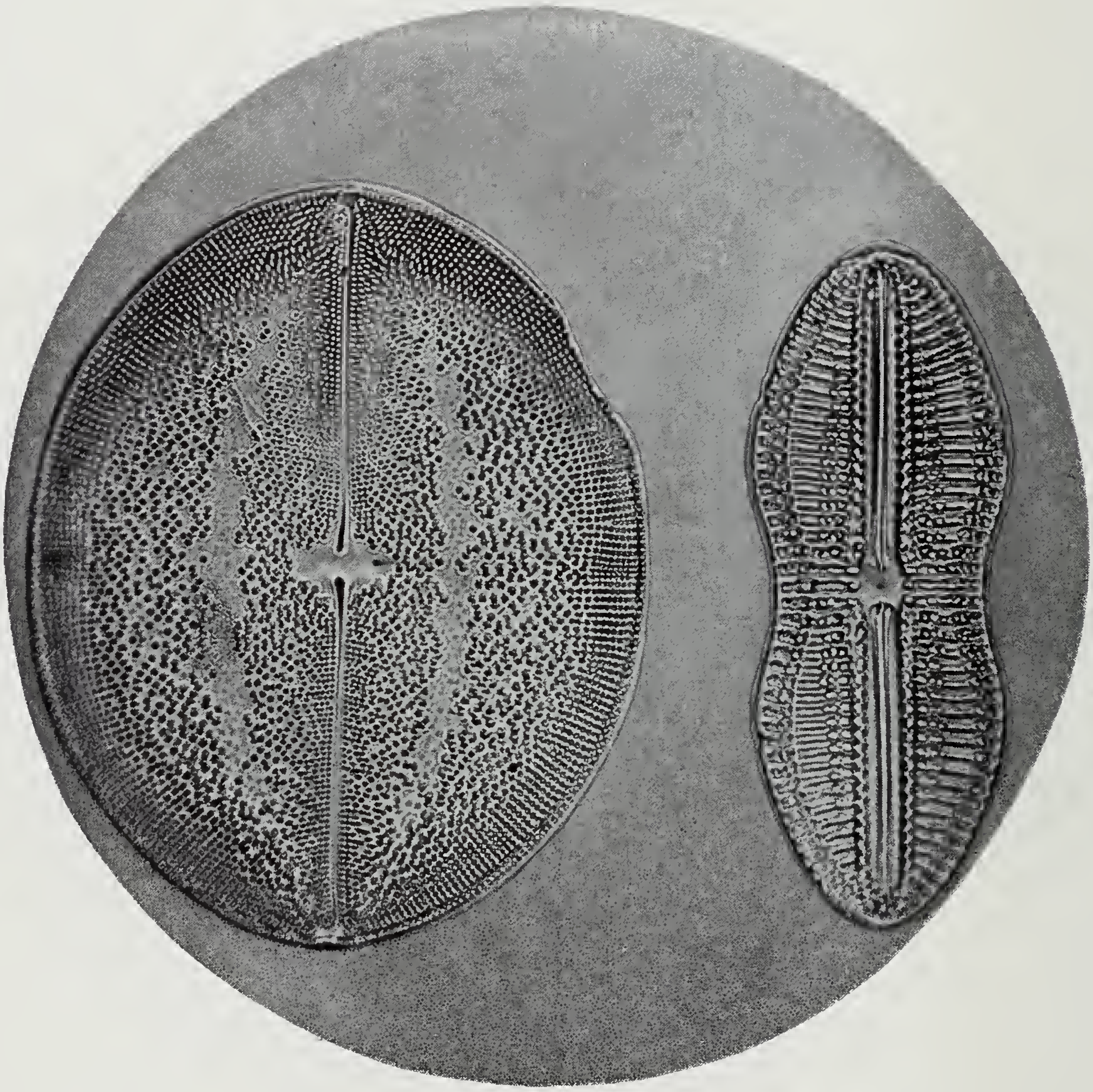

PHOTO No. 7. Navicula. Magnification 750X.

The principal impurities of Celite are very fine quartz grains, clay particles, amorphous silica, minute flakes of volcanic ash, traces of inorganic salts and small amounts of organic matter.

(2) The second variety of diatomite is also light weight, white to cream colored, but shows less of the minute stratification planes. It generally has a conchoidal fracture. Changing depositional conditions produced this type of diatomite.

Stratified 'Heavy' Beds:

These are the heavier clayey diatomites that are interstratified with the pure, thinly laminated ones. They represent periods where the sea water became dirty with clay, silt and volcanic ash. Diatom deposition continued, but not nearly so rapidly. The beds are found to contain as much as 10% alumina. The diatomite in the least stratified portions is slightly plastic when well wetted.

It is notable that even the most impure diatomites have an apparent density of less than 1. All of them will float on water an appreciable period before becoming saturated and sinking. Even in these 'heavy' beds the cleavage is roughly horizontal.

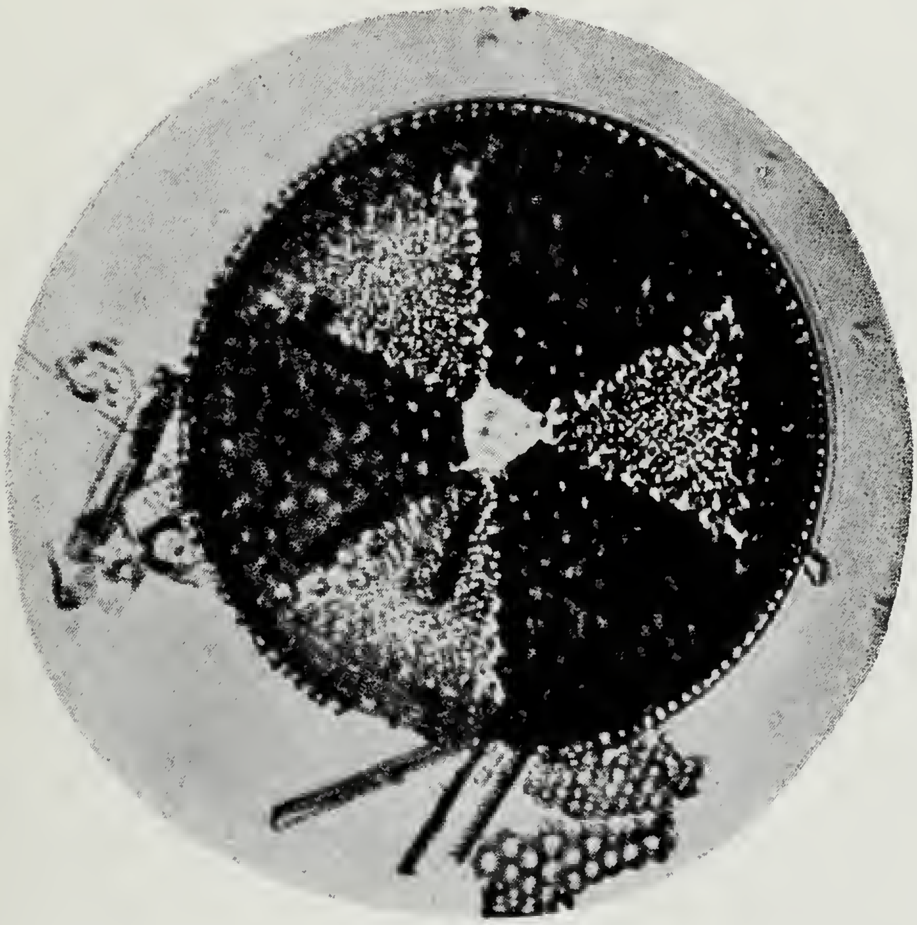

PHOTO NO. 8. Actinoptycus. Magnification 900X.

Volcanic Ash:

Much has been written about Miocene volcanic activity and the presence of tuffs and ash in the Monterey shales.

Here the volcanic ash appears in two ways—scattered throughout the beds of diatomite, or as interstratified streaks.

The volcanic ash in both cases is extremely fine-grained, seldom larger in particle size than the diatoms themselves. The grains are always platey, light-colored, and have sharp angular outlines. This sharpness of outline indicates little change by erosion, and also that they were dropped as dust into the sea water very close to the point of deposition.

The more important occurrences are the streaks that are found at definite horizons. They may vary in thickness from $\frac{1}{16}$ inch to as much as six inches. The color is always a silver gray, the particles are sharp and bright. Chemical analyses place them in the acid class of volcanics, quite possibly rhyolite.

Invariably, these streaks contain few if any diatoms except on the top and bottom sides. The centers are nearly pure volcanic ash of a nearly uniform particle size.

In one instance two pure diatomite strata are divided in the middle by volcanic ash having a thickness of not more than two inches. This stratum of ash is present every place on the property, but always at exactly the same horizon. This is true of three other streaks ½ inch wide and the one 6 inches wide which occurs low in the structure.

'Flints' in the Soft Diatomites:

Hard, opalized shales, locally called 'flints' are interstratified with the soft diatomites. The author knowing the great diversity of opinion about them, will not attempt to establish the cause of their origin, but will simply state the facts regarding their occurrences in this deposit.

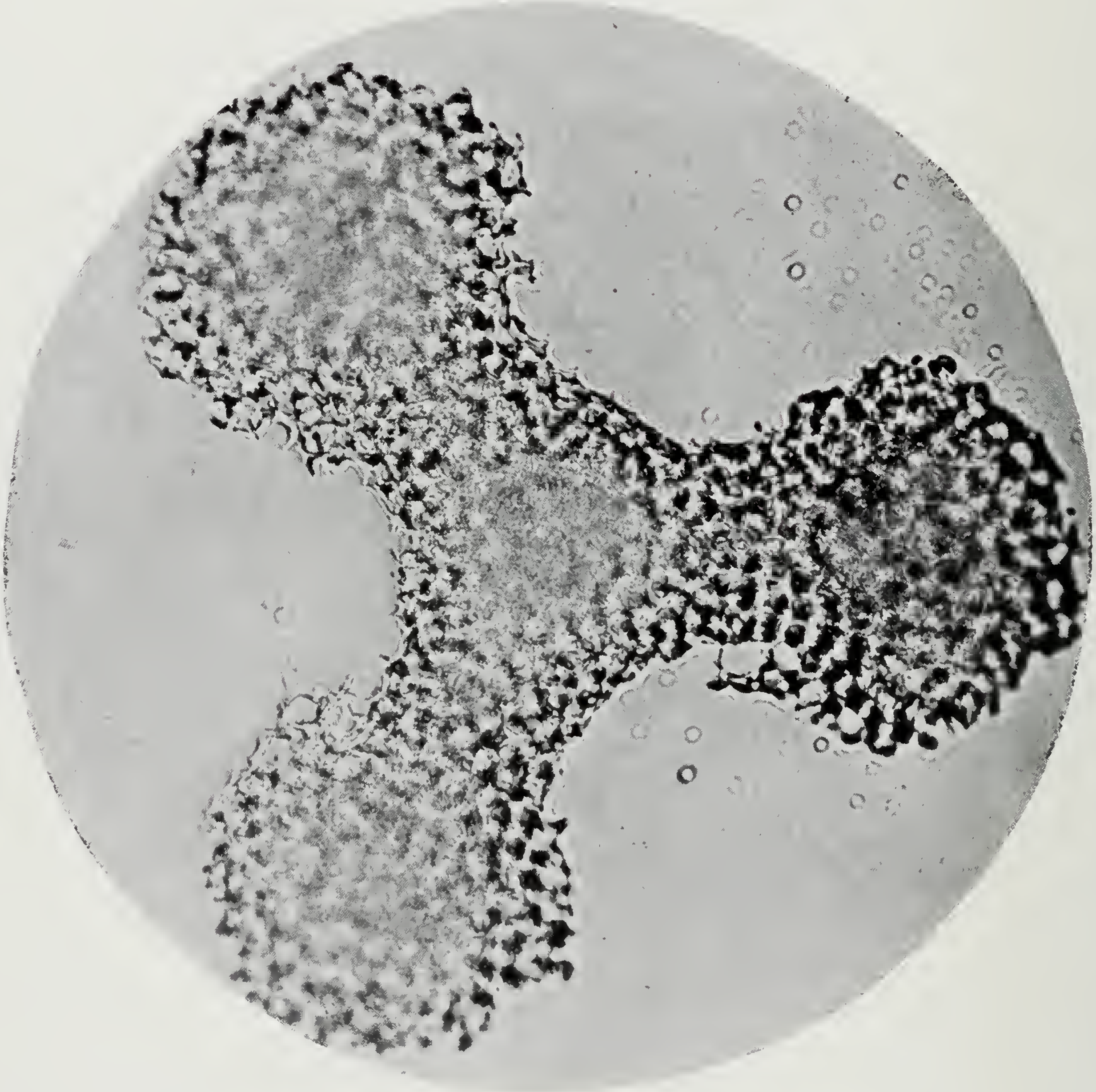

PHOTO NO. 9. Radiolaria. Magnification 900X.

There are several kinds of 'flints.'

(1) Hard nodular concentrically banded.
(2) The same showing a high degree of leaching.
(3) Interstratified, black, opalized strata showing exactly the same banding as the enclosing soft diatomites.

(4) Hard, white intermittent calcareous 'flints.'
(5) Opalized 'flints' that show gradation from hard glass to extremely soft, porous, spicular diatomite.

All 'flints' excepting (4) and (5) are located at definite horizons throughout the property. They are always present in the same strata wherever it occurs whether it be in synclines or anticlines, at the top of a structure or at the bottom.

They always occur surrounded by diatomite of extreme purity. They seldom occur in the less-pure beds.

'Flints' (4) and (5) may appear anywhere in the diatomites.

General Uniformity of the Diatomites:

The diatomite in the main synclinal structure is remarkable for its degree of uniformity every place it has been examined.

The chemical analysis of a given stratum will vary only slightly from top to bottom, except for the change where hydro-carbons and organic material are found. The diatom content, that is the mixtures of certain types, is practically constant. In cases where a stratum's use is dependent on a definite diatom mixture, a particular stratum will show little if any change at any level or in any quarry.

Regular horizons are established by thin clayey streaks, certain 'flints,' volcanic ash streaks, and many other tiny features that would not ordinarily be noticed.

A six-inch solid, hard, glassy 'flint' showing rythmic banding is found everywhere 25 ft. above this $\frac{1}{32}$-inch seam of dark material. The 2-inch volcanic-ash seam has already been mentioned. Such regularity of beds of pure material and impurities certainly indicates a quiet depositional period in a region little affected by erosional or other agencies.

Fossils:

The author has found no foraminifera. Microscopic life other than diatoms appears to be composed of large quantities of sponges (usually of a needle-like or spicular nature), silico-flagellates, and occasional radiolarians. No fossil shells have been found, other than two rock-borers found in a piece of opalized shale six inches square by three inches thick.

Numerous concentric nodules seldom more than one inch in diameter and $\frac{1}{2}$ inch thick appear in various strata. These are green-colored, soft, and are generally believed to be the remains of soft organisms.

Fossil fish are numerous. Dr. Jordan describes some of them in the publication quoted. In general, they occur singly with no relation to each other nor to any given stratum.

One outstanding case is one of a school of *Xyne Grex* an extinct type of herring, according to Dr. Jordan (see photo. No. 11). These fish, uniformly six to eight inches long, lie in a pure diatomite stratum six feet below the two-inch volcanic ash locally called 'silver sand.' They are packed solid, but seldom overlap each other. They occur 1000 ft. along the strike and 250 ft. down the dip directly behind the milling buildings. Every part of the fish is preserved, excepting of course the flesh. The tails, fins, back bones, ribs and scales are always in excellent

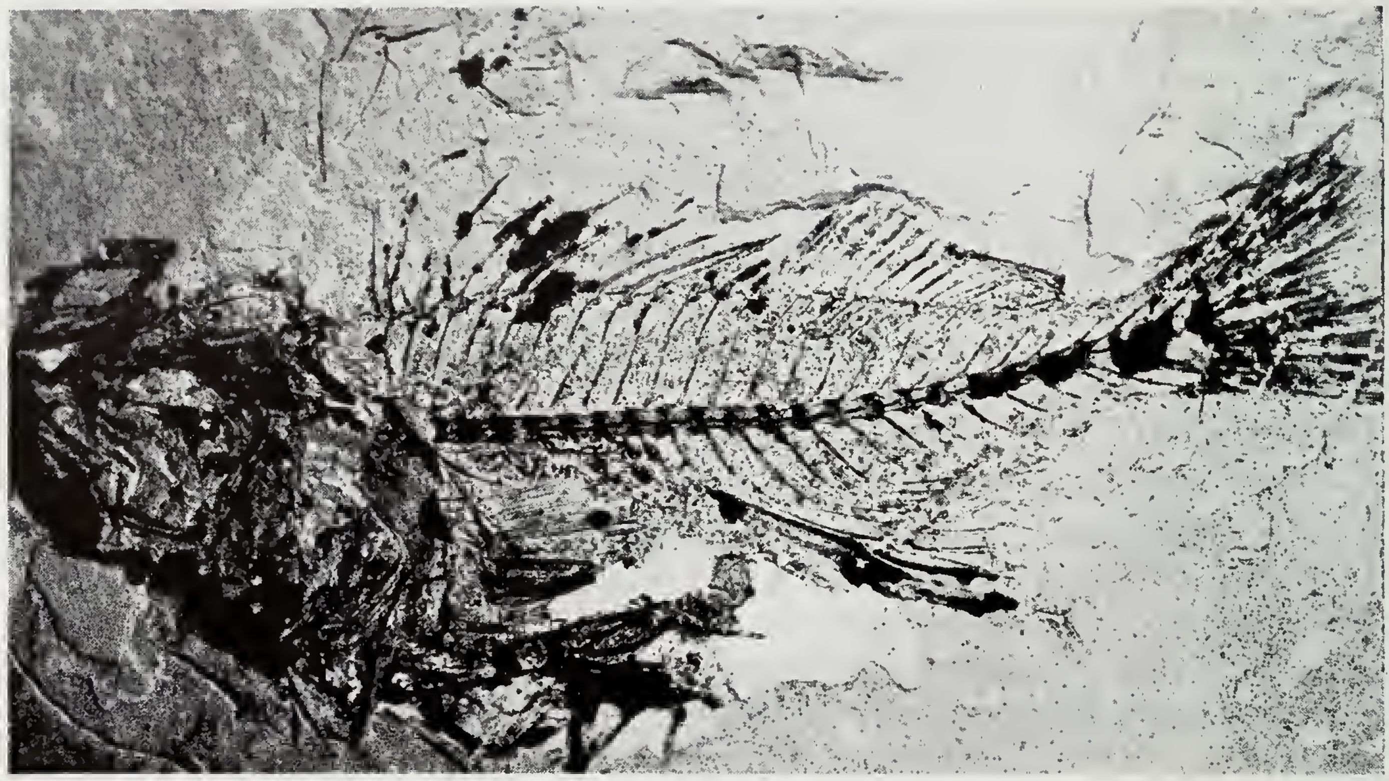

PHOTO No. 10. Fossil fish obtained recently.

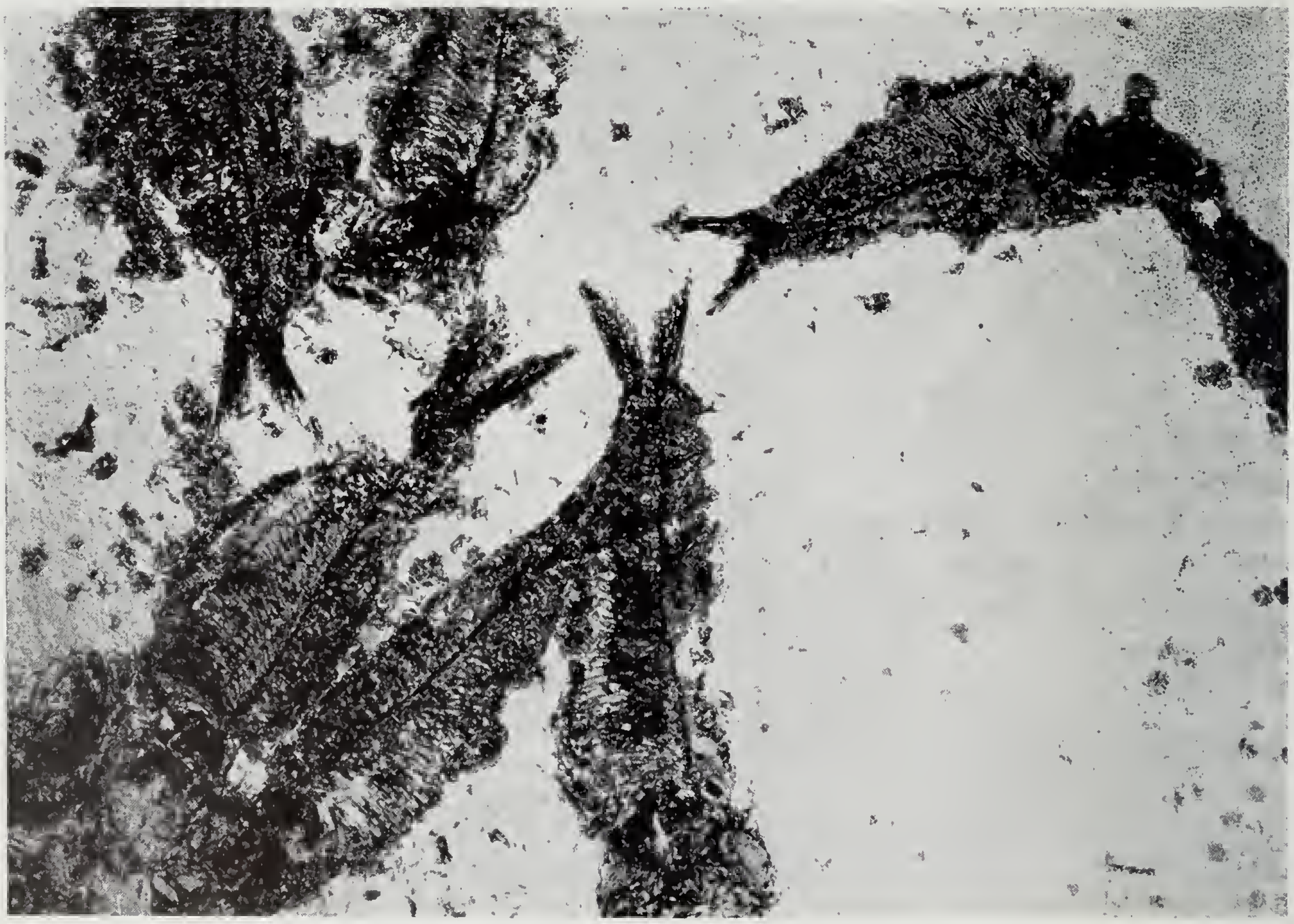

PHOTO No. 11. Fossil *Xyne Grex* from the "Fish Strata." Individuals are from 6 to 8 inches long.

condition. The head does not preserve so well but it is always well-defined.

Sponge spicules are usually well concentrated around the fish remains. The cause of their death in such great numbers is one of conjecture. It is possibly due to a change in alkalinity of the sea water, temperature variations, or the presence of poisonous solutions probably emanating from submarine volcanic activity nearby. The single fish often found, vary in length from one and one-half inch to more than 3 ft. In every case circles of sponges are found with them.

Fossil birds are found occasionally. They are fairly well preserved specimens of shore or wading birds.

One piece of silicified drift wood was dug out of pure diatomite bed. It had become embedded in the diatom ooze, its woody structure being replaced by silica, all of the original structure including the bark being excellently preserved. Pebbles are so rare as to be curiosities.

Larger marine life consists of the skeletal remains of seals, sea lions, sea cows, and whales. One backbone of what is believed to be a sea lion reposes in a museum case in the plant office.

Numerous whales have been found, especially in the area where the sawing of natural brick takes place. In one instance a toothed whale was removed, the teeth being well polished and rounded. The length of the longest tooth was three and one-half inches. In general, where whales are found the inside of the head is always replaced by a hard mixture of silica and calcite.

At the very top of the formation is found the conglomerate containing innumerable bones and occasional shark teeth. The teeth range in size from one-quarter to three inches in length.

For a description of some of the fish the reader is referred to the previously quoted article by Jordan and Gilbert.

An excellent description of a few fossil birds is contained in "Avian Remains from the Miocene of Lompoc, California," by Loye Miller, Publ. No. 349, Carnegie Inst. of Washington, pages 107–117.

Microscopic Examination

As the quality of diatomite and its utilization are due to the numbers, types, and mixtures of diatoms present, it is necessary to check the testing microscopically.

The powder is weighed out, distilled water added, enough of the agitated liquid and powder withdrawn to cover a cover glass. These are desiccator dried, mounted in Hyrax, and examined with an ordinary microscope. The outlines of the diatoms are very sharp in Hyrax.

A predominance of fines, broken diatoms, clayey, or volcanic ash particles indicates a diatomite of little value for filtration purposes. An even mixture of discs and needle-like forms usually indicates a high quality filtration crude.

In like manner diatomites for admixtures, fillers, and insulation can be determined microscopically.

Mining Methods

The original mining methods consisted of hand removal of diatomite where there was little or no overburden. It was split into lumps, piled in rows 6 ft. high and 3 ft. wide, and allowed to dry in the flat fields receiving the greatest amount of wind and sun. In 45 to 60 days (excepting winter) the diatomite had lost 30 or 40% free moisture, there being usually not more than 8 to 10% remaining.

This method was necessarily confined to areas where the overburden could be removed with little effort and cost, Fresno scrapers pulled by mules being used. The work was slow and expensive, the loss in the form of fines as high as 50%.

In time, improved methods were developed. Double-drum or tandem-drum electric hoists pulling locally designed toothed-buckets scraped the overburden to the edges of the quarries. Channeling saws were developed to saw the diatomite into four-foot cubes. A bottom cut was made on a 25°-dipping face, and the blocks loosened with picks.

Photo No. 12. Diatomite quarry of Johns-Manville Company at Lompoc, Santa Barbara County.

Photo by Walter W. Bradley.

The blocks slid to the quarry heel where they were split into large lumps, loaded to wagons, hauled to the drying fields and piled for air drying.

It was found that some diatomite could also be quarried directly with draglines. The buckets emptied into chutes which unloaded to bottom-dump wagons, and later, automobile trucks.

Gasoline shovel and surface-train loading came later. The trains have become obsolete as well as aerial tramming, and now gasoline and diesel-powered shovels with trucks perform all overburden stripping and diatomite quarrying.

All transportation of diatomite to the primary crusher is accomplished by electric trolley trains underground.

Surface Quarrying:

The beds of diatomite vary in dip from flat to 50°. The overburden ratio becomes so high it is possible to quarry on only one side of a fold at a time.

The layout of the overburden removal and diatomite quarrying is generally the same for each quarry, excepting for local variations.

The general trend is toward excavation by power shovel and transportation by trucks. Roads are graded, graveled, and smoothed for rapid movement to the dumps.

Quarrying by shovel and trucks begins at the outcrop, working along the strike to the end of the quarry, and then making new cuts at successive intervals down the dip.

It is not possible to work circular open pits, due to the dip of the strata and the requirement of selective quarrying.

Drilling and Blasting:

Drilling and blasting are seldom done. The shovels are powerful enough to quarry the diatomite without aid. Blasting is only resorted to where it will speed up the operations or in the removal of thick layers of 'flint.'

In drilling down-holes in diatomite, compressed air jackhammers are used. No water is added, the cuttings being blown out. As they have 40% to 50% water there is no dusting. They are usually sprung with 40% dynamite and No. 8 electric caps, the holes later being filled with granulated powder and detonated with No. 8 electric caps. A hand battery or 110-volt electric line is used for firing.

When drilling 'flints' the jackhammer is used to drill holes seldom more than three feet deep. A series of holes is loaded with 40% dynamite and electrically detonated. If more than one parallel series is to be blasted, delay electric caps are used.

Dragline Excavation:

Some quarries can be more economically worked with dragline buckets. A permanent set-up is made, power line established and the bucket proceeds to remove overburden to the quarry edges, or in the case of diatomite recovery, drags the material into vertical storage shafts. This method is slower than shovel work, but is quite satisfactory in some cases. Sauerman Crescent buckets with hardened teeth are now used for excavation.

Underground

Glory Holes:

The primary crushing plant being located underground, receives its diatomite through vertical shafts (known locally as 'Glory Holes'), and the main transportation tunnel.

The holes are all circular, varying in diameter from 12 ft. to 36 ft. They are unsupported inside, the walls showing very little tendency to cave even when the holes are empty for some time. All holes have concrete chutes at the top to prevent wearing away of the walls when diatomite is dumped into them.

The shovels load diatomite to the trucks which haul it to the glory holes where it is unloaded, and the underground train hauls it away at the bottom as required by the milling plant.

Tunnels:

The total footage of actively used tunnels is 9614 ft. all of which is contained in the main transportation system. The main tunnel, 7000 ft. long, has branches running to various glory holes at selected locations.

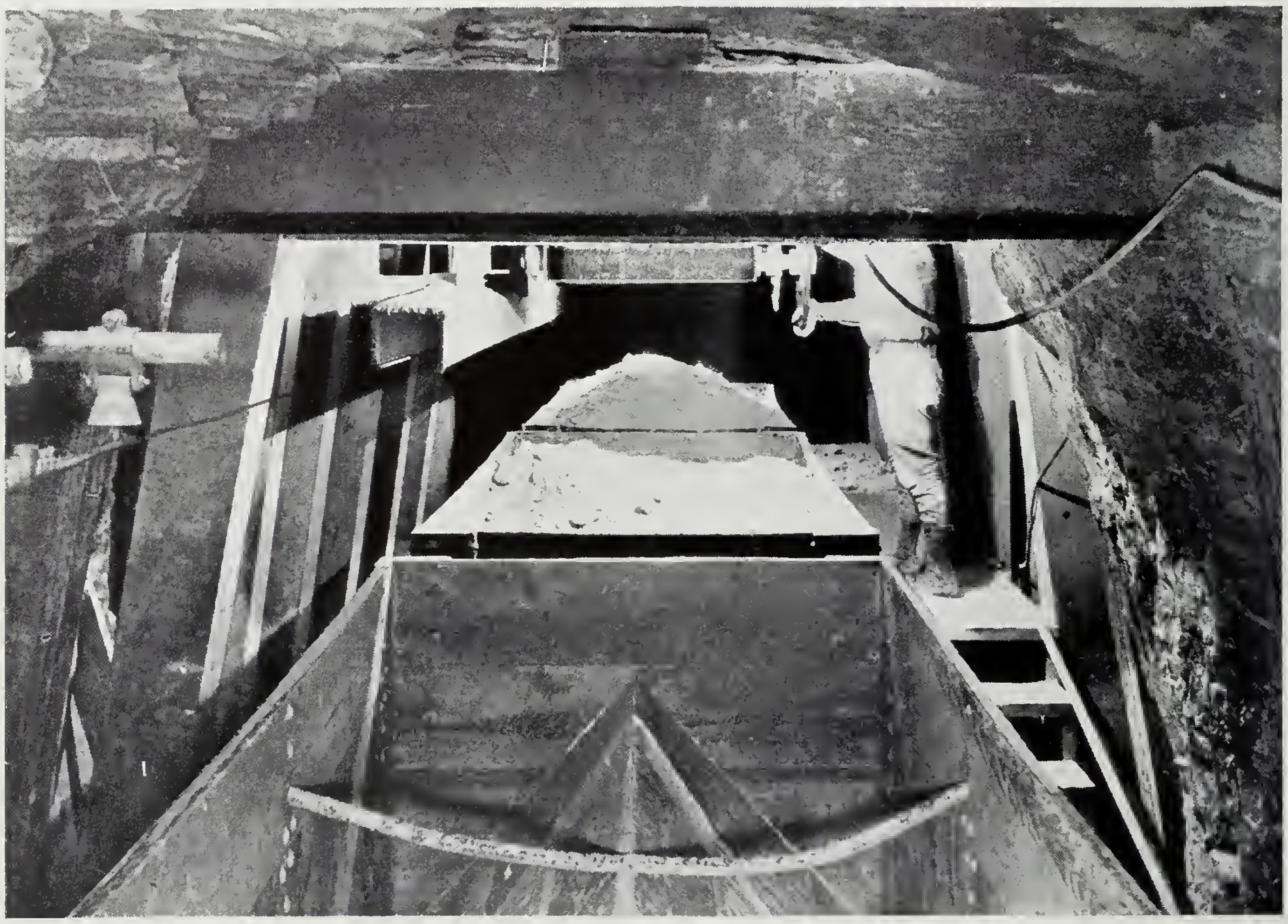

Photo No. 13. Underground loading of cars from vertical storage shaft (glory hole). All columns and supports from the glory-hole bottom, except the one at the extreme left, are concrete.

Little timbering is required. Only in zones where the roof is weak are caps and posts used, the caps being niched into the walls. The stations where the tunnels branch are all timbered with treated lumber and loosely lagged on the roof. The glory-hole bottoms are concrete, some of the posts being precast.

Ventilation:

In the driving of the tunnels and raising of the stopes the smoke and gases are removed by blowers until such a time as a raise on the dip can be put through to the surface. These are run through at regular intervals providing excellent natural draft.

The moisture being as high as 50% makes mining operations dustless. There is no free water underground.

The driving of a tunnel then is comparatively simple as the rock drills and breaks well, grades are maintained easily, the ventilation is good, and there is no dust nor water with which to contend.

Timbering:

As mentioned before little timbering is required, except in stations where the opening is too wide for safety. Then treated 8 x 8-inch or 10 x 10-inch timbers are placed as for a drift set and lagged loosely on the top with 2 x 12-inch rough boards.

It becomes necessary in weak zones to catch up the roof occasionally, and when this is necessary posts and caps are used, the latter being easily niched into the diatomite walls. The glory-hole bottoms used to be supported by timber, but the new trend is to make them of concrete with concrete posts for supports. In some areas, especially in the vicinity of large gloryholes, concrete precast caps and posts are used for ground support.

Transportation:

All underground transportation is by means of trains powered by electric trolley locomotives.

Primary Crushing Plant:

All diatomite destined for pulverizing into powdered form passes through the primary crushing plant. The electric locomotive hauls the trains of diatomite underground from the storage shafts (glory holes) to the crude bins.

PHOTO NO. 14. A partly completed stope. It has been holed through to the surface at an average width of 20 feet and height of 12 feet. It is connected with other stopes by crosscuts at regular intervals.

It is then fed by hand to a belt conveyor underneath. This belt conveys the material to a short cross-conveyor which in turn carries it to the milling machinery. A second bin having an automatic unloading bottom feeds directly onto the cross belt having a magnetic pulley

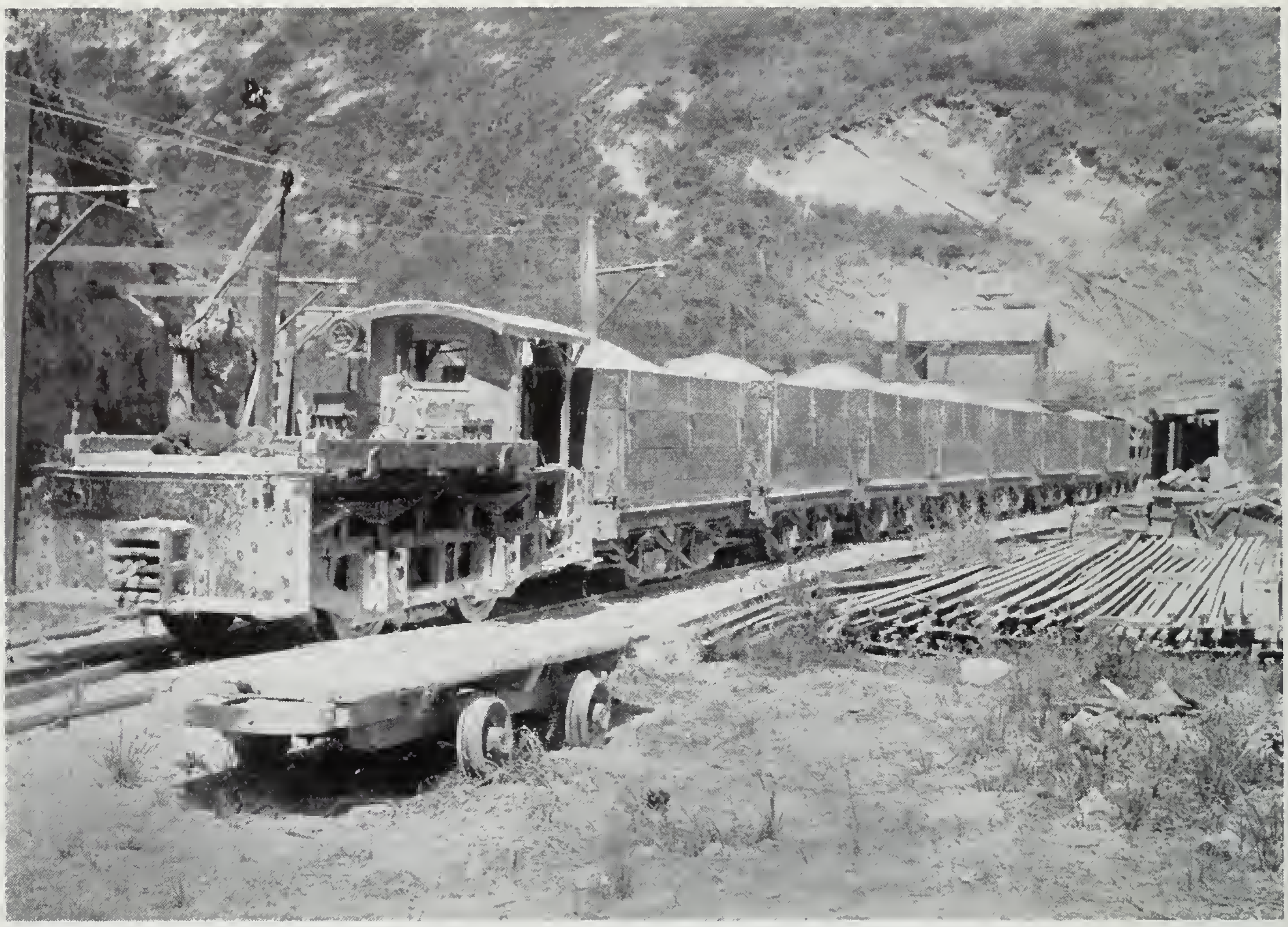

Photo No. 15. A trainload of crude diatomite loaded from a storage shaft (glory hole). It has been transported underground more than a mile. It will pass through a 600-foot tunnel to the primary crushing plant.

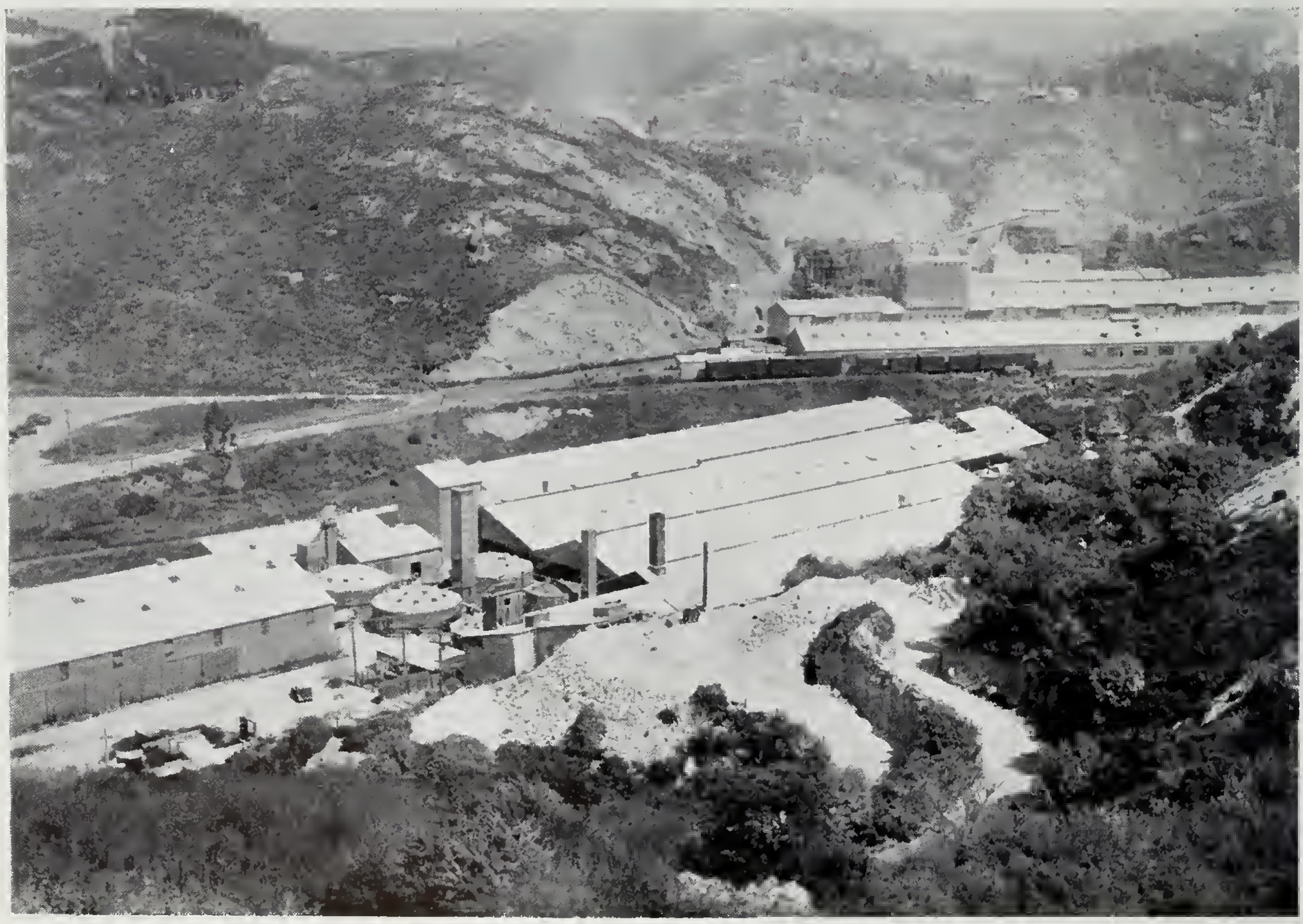

Photo No. 16. General view of the milling plant, warehouse, machine shop, and storeroom, in background. The brick plant and warehouses are in the foreground.

at its front end. Tramp iron is thus by-passed from the milling system.

Lumps of diatomite not more than 30 inches wide and 1 foot thick are fed over the magnetic pulley into a pair of revolving rolls set with four-inch spikes.

The coarsely crushed material drops by gravity into one of two high-speed mills. The grid openings on the bottom are changeable at will. The largest particles are 1 inch square by ½ inch thick, the average being less than ¼ mesh. The primary crushing plant has capacity sufficient to take care of all powder requirements daily.

The bar-milled diatomite is belt conveyed to any of six storage bins which feed directly into the secondary milling systems. Under normal operating conditions the train crew loads the cars, hauls them to the storage bins, and then mills the diatomite. This is a three-shift operation.

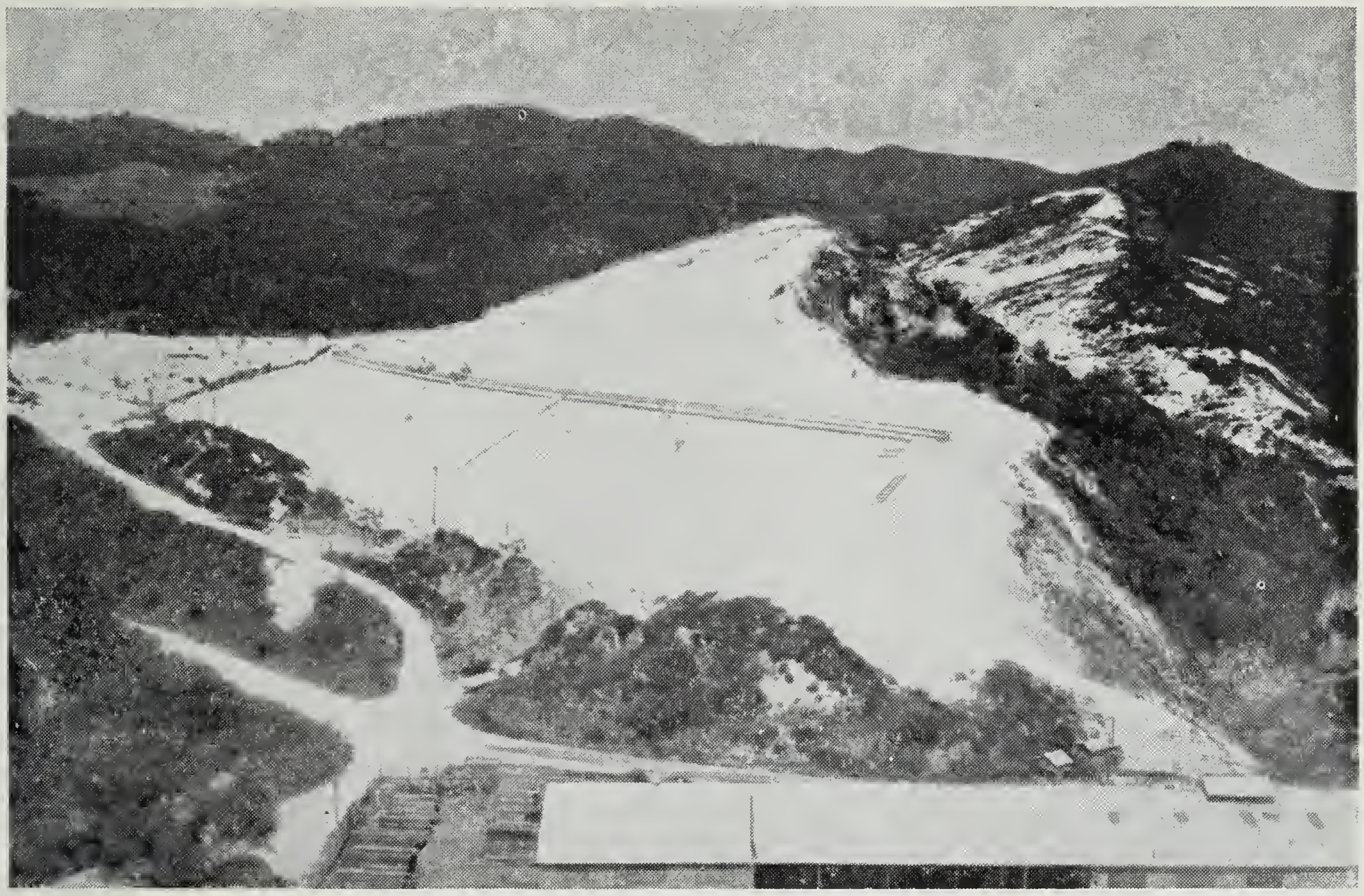

PHOTO NO. 17. Brick-cutting machine on diatomite deposit of Johns-Manville Company, Lompoc, Santa Barbara County.

Photo by Walter W. Bradley.

Natural Brick

The method of recovering standard-size insulating brick is unique at Lompoc. Blocks of natural diatomite are sawed by machines in the quarries to standard dimensions of 2½ x 4½ x 9 inches.

A quarry suitable for the sawing of brick is stripped of overburden by shovel or dragline excavation, the floor smoothed to the dip of the stratum. To the present the dip has not exceeded 25° on these quarries.

A heavy steel track is laid across the quarry face parallel to the strike (right angles to the dip). (See Photo No. 17.) Upon these rails are mounted three machine saws operating electrically and hydraulically.

The machine in the center is a face cutter having circular saws and inserted teeth turning at right angles to the strike, sawing the lengths of nine brick. The machine head cuts rapidly downward in a direction at right angles to the floor for five feet, and into the bank for 4½ inches. The machine is moved to the end of the last channel and the head cuts rapidly, upward this time, to the top of the bank.

In the first cut the lengths have been sawed 4½ inches thick. A similar number of brick were cut to length on the upward cut. This process continues until the bank 4½ inches deep has been channeled for the lengths of all the brick on the 5-foot bank.

The next operation is to saw the widths and thicknesses. The machines on either end have two sets of saws mounted on their heads. The saws are circular and have the same type of inserted teeth.

One motor has three circular saws mounted 2½ inches apart, the saws revolving in a plane parallel to the stratification. The other motor has one circular (tail) saw mounted behind the one just mentioned, the rotation of which is parallel to the 5-foot bank (right angles to the three saws). It is set in far enough to saw a 4½-inch cut.

A machine moving continuously across the quarry floor then has three saws whirling against the bank and sawing the thicknesses of two brick, while another saw, the tail saw, whirls parallel with the bank sawing out the 4½-inch widths of the two brick.

The lengths have been sawed previously by the center machine, the thicknesses and widths sawed nearly simultaneously by one of the other two saws or by both operating in opposite directions.

When the saws have reached the ends of the quarry floor the machine direction is changed, saws with new or sharpened teeth are attached and the journey is resumed back to the original starting place, sawing the widths and thicknesses of the next two lower brick. This operation continues until 18 to 20 layers 2½-inch thick have been sawed out leaving a smooth face again. The vertically sawing face cutter is brought into use and the entire bank again channelled for the lengths of the brick, whereupon the two moving machines resume sawing the thicknesses and widths.

The length of the tubes of the face cutter is such as to allow sawing for 5 feet down the dip. When this limit is reached the track with the saws is lowered down the hill 5 feet, aligned and braced, and sawing operations are resumed as before.

As the tail saw cuts the widths the brick are loosened from the bank and lie on the solid bank below. They are then sorted and placed in boxes.

When a box is full of brick it is attached to a drag-line which hauls it to a point under one of two aerial conveyors known as Ruggles hoists. They are picked up by the Ruggles hoists, conveyed by aerial cable to a vertical shaft into a tunnel where the boxes are landed on flat cars. A train load powered by a Ford engine locomotive is hauled to the brick plant for farther handling.

Drying:

The brick are transferred by hand from the quarry boxes to tunnel drier cars at the brick plant. A second inspection takes place here and brick with broken corners, split brick, etc., are thrown out.

The drier cars are run through tunnel driers at a regulated rate at temperatures up to 500° F. A hydraulic ram forces the train of cars through the driers.

After thorough drying the cars of brick are transferred by trolley car to the sizing machines.

Sizing and Packing:

In the quarries it is easy to control the lengths of the brick. The dimensions of widths and thicknesses show variations due to uneven floors, worn teeth, and many natural causes. Sizing machines are employed to provide uniformity in these dimensions.

By a cross conveyor belt the brick are carried to a belt traveling at right angles to it. The brick fall upon this belt with their length toward the sizing wheels (carborundum) and the wide sides up. The brick pass between two wheels, the 4½-inch width being smoothed off. Passing on they turn so that the 2½-inch side is upward and then pass between two more sizing wheels where the 2½-inch dimension is smoothed. The finished brick pass onto a steel plate where an inspector gives them a final examination. The brick with broken corners, impurities such as 'flint' and clay, and undersized are rejected.

The satisfactory brick, in groups of five brick, are placed on an inclined roller conveyor. They are conveyed by gravity to a point where they are placed in heavy paper cartons, sealed, warehoused or loaded directly to freight cars or trucks.

Pressed Brick

Two types of pressed brick are manufactured in the Brick Plant, a simple aggregate and an aggregate containing a binder. The preparation for pressing is identical except for the addition of the binder.

The crude diatomite is hauled to the crushing plant by truck from the quarries. It is fed by Fresno scraper or by hand into a high-speed bar-mill with coarse-grid openings. The coarsely milled crude is conveyed by rubber belts to a cylindrical revolving screen. The oversize is returned to the crusher by belt conveyor, the undersize fed to the pugger where about 150% water is added. The mixed aggregate and water passes into either of two Fernholtz presses with mold boxes for four brick each. Poorly pressed brick are returned by bucket elevator to the pugger.

The pressed brick are placed by hand on tunnel-drier cars in a definite pattern to receive the most efficient drying. (See Photo No. 18.) The tunnel cars are passed through the tunnel driers at regular intervals, the moisture being completely removed.

The thoroughly dried brick are treated in two ways. The simple aggregate brick is usually fired in a tunnel kiln; the bonded aggregate brick being fired in down-draft beehive kilns.

The calcined brick, now slightly pink-colored, are unloaded by hand to a gravity roller conveyor where they are inspected prior to packing. Soft, punky, crooked or broken cornered brick are rejected. The satisfactory brick pass on down the conveyor to a point where they are packed 25 to a corrugated paper carton and then warehoused. Each brick is examined for physical defects by the inspector and sample brick from each day's production are tested. They are sold as Silocel C-22 Brick.

PHOTO NO. 18. Diatomite brick ready for calcining kiln, Johns-Manville Company, Lompoc, Santa Barbara County.

Photo by Walter W. Bradley.

The bonded dried brick are placed by hand in the beehive kilns. The temperatures are gradually increased to the proper conditions, which includes a soaking and cooling period. These brick are white, strong and also of standard size 9 x $4\frac{1}{2}$ x $2\frac{1}{2}$ inches, having shrunk exactly 10%. They are known as Silocel Super Brick and are used for insulation where the temperatures are not higher than 2500° F.

All of the kilns and tunnel driers are fired with natural gases. The waste heat from the cooling zone of the tunnel kiln aids in the drying of the pressed and also natural brick.

Aggregates

Natural:

Crude from the quarries is ground in a bar mill of local design. The bars are attached rigidly to a shaft which turns at about 1800 r.p.m. The material is fed into the mill, and contained therein until of small enough particle size to pass through the grid bars at the bottom. The product is mechanically screened, the fines going to a packer bin, the oversize returning to the mill. The product is sacked by gravity into burlap bags, a full sack weighing 100 pounds.

The product known as Silocel coarse grade or building insulation is especially suitable for insulations where the temperatures are not higher than 1600° F.

Calcined:

Crude diatomite, hand-quarried, piled in rows, and air dried is fed into a natural-gas-fired vertical kiln 60 ft. deep. It is calcined and the finished product is drawn off at the bottom by gravity. A hand-trammed steel mine-car carries the calcined diatomite to a bin where it is stored until ready for crushing at the mill in Lompoc. The same equipment is used as for the milling of the natural aggregates. The product known as Silocel C-3 is suitable for insulation at temperatures as high as 2000° F.

The vertical kiln is unique in that it is a shaft 12 ft. in diameter sunk in solid stratified diatomite. It is lined with fire brick and has the whole hillside acting as an insulation medium.

PHOTO NO. 19. Rotary calcining furnace for diatomite, Johns-Manville Company, Lompoc, Santa Barbara County.

Photo by Walter W. Bradley.

Products and Principal Uses

Filter Aids:

Three powders for filtration work are dried, milled and processed, namely Filter Cel, Standard Super Cel, and Hyflo Super Cel.

Filter Cel is natural dried, milled and processed Celite. It is slightly buff colored, light weight, soft and generally chemically inert (except with hydrofluoric acid and strong alkalis which dissolve all diatomites). Its chief use is where a high degree of clarification of a liquid is the prime requisite.

Standard Super Cel is dried, milled, processed and calcined in a rotary kiln at elevated temperatures. The resulting powder is lightweight, cream to slightly pink colored, chemically inert, and from which the chemically combined water has been removed. Its chief use is as a filter aid, on liquids with larger suspended particles that do not necessitate the fine screening produced with Filter Cel. The rate of flow of filtrate is nearly twice that when Filter Cel is used.

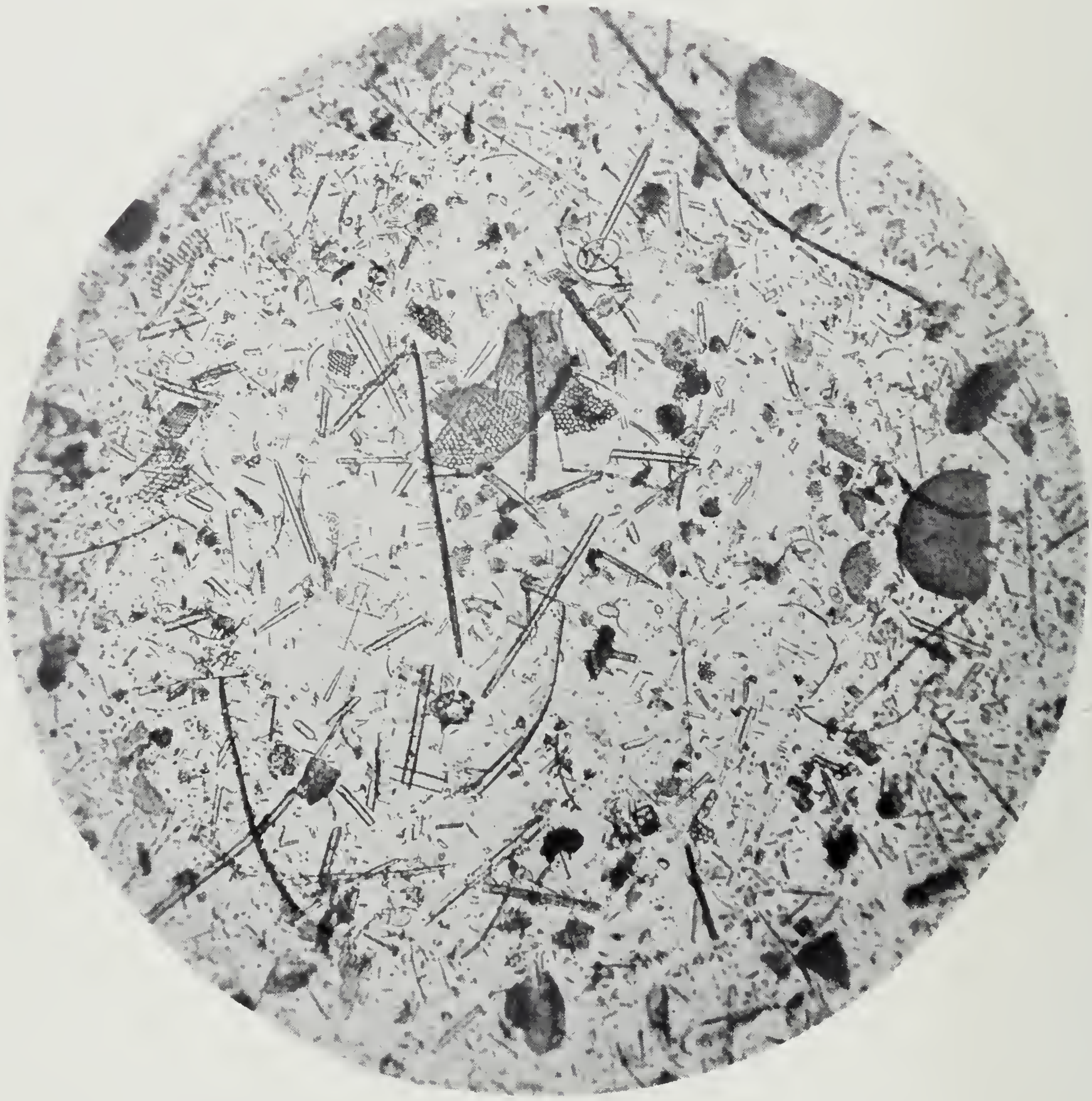

PHOTO No. 20. Filter Cel. Magnification 160X.

Hyflo Super Cel is treated exactly the same as Standard Super Cel, except for the addition of small amounts of an alkaline flux. The powder is light weight, dead white, chemically inert. It is used as a filter-aid where speed of filtration is the desired object with satisfactory clarification. It is also used on liquids that can not be filtered with the other products. The flow rate of filtrate is three times that of Standard Super Cel.

By special refining are obtained variations of these powders which have special filtration uses.

Admixtures and Fillers:

The same general processes are used to manufacture various types of powders for light weight mineral fillers, for large variety of use, such as admixtures in asphalt, and as admixtures for concrete to make that material more workable and smooth. The white powders are used in paints of various kinds, the finer processed grades for polish.

Insulation:

Natural powders and calcined powders are used as insulation products, where heat losses from high temperatures are to be decreased.

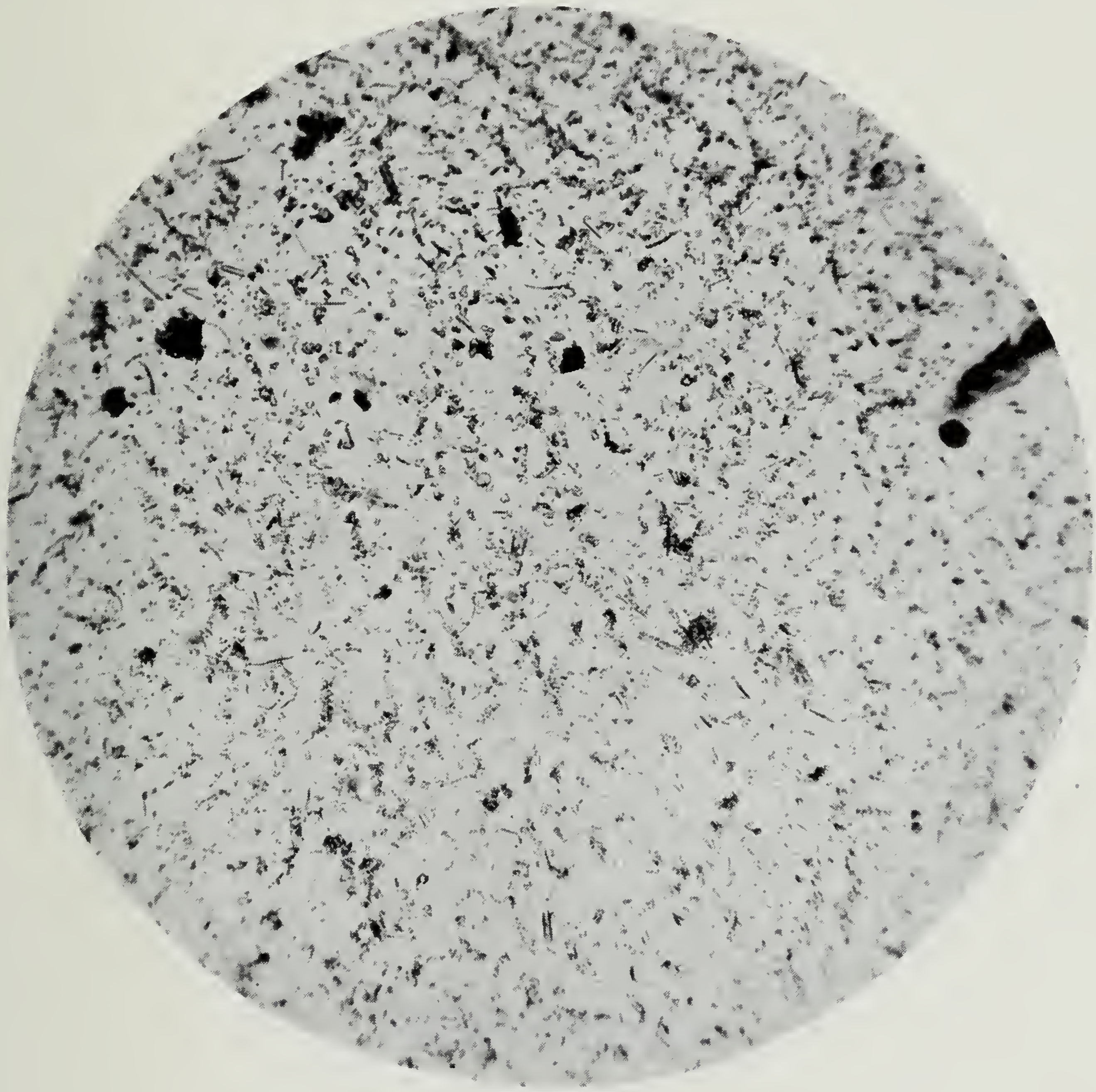

PHOTO NO. 21. Snow Floss. Magnification 160X.

The powders are milled and processed similarly to those mentioned. Coarse aggregates for insulation have been mentioned previously.

The natural Silocel brick are used for insulation where the temperatures do not exceed 1600° F. The Silocel C-22 brick are used for insulation at temperatures not exceeding 2000° F. The Silocel Super Brick are used for insulation at temperatures not higher than 2500° F.

Molded and pressed brick as well as natural brick can be made into any special shape that might be required for the insulation of special equipment.

Summary of Uses:

Briefly summarizing, the principal uses of Celite Diatomite Products are: In insulation at comparatively high temperatures, also low temperatures, building insulation, in filtration of all types of liquids from the most viscous to the least viscous; as admixtures and mineral fillers where a chemically inert light-weight mineral is required, as a mild abrasive in polishes, and a filler in paints.

Research and Development

In the early operations the diatomite was simply mined, air-dried, and shipped in lump form. New uses being established, it became necessary to pulverize the diatomite and sell it as a powder. The powdered material gradually assumed more uses and the Celite Company realized a research department would quickly evolve new processing methods and new products, and at the same time provide technical control of the operations to insure uniformity.

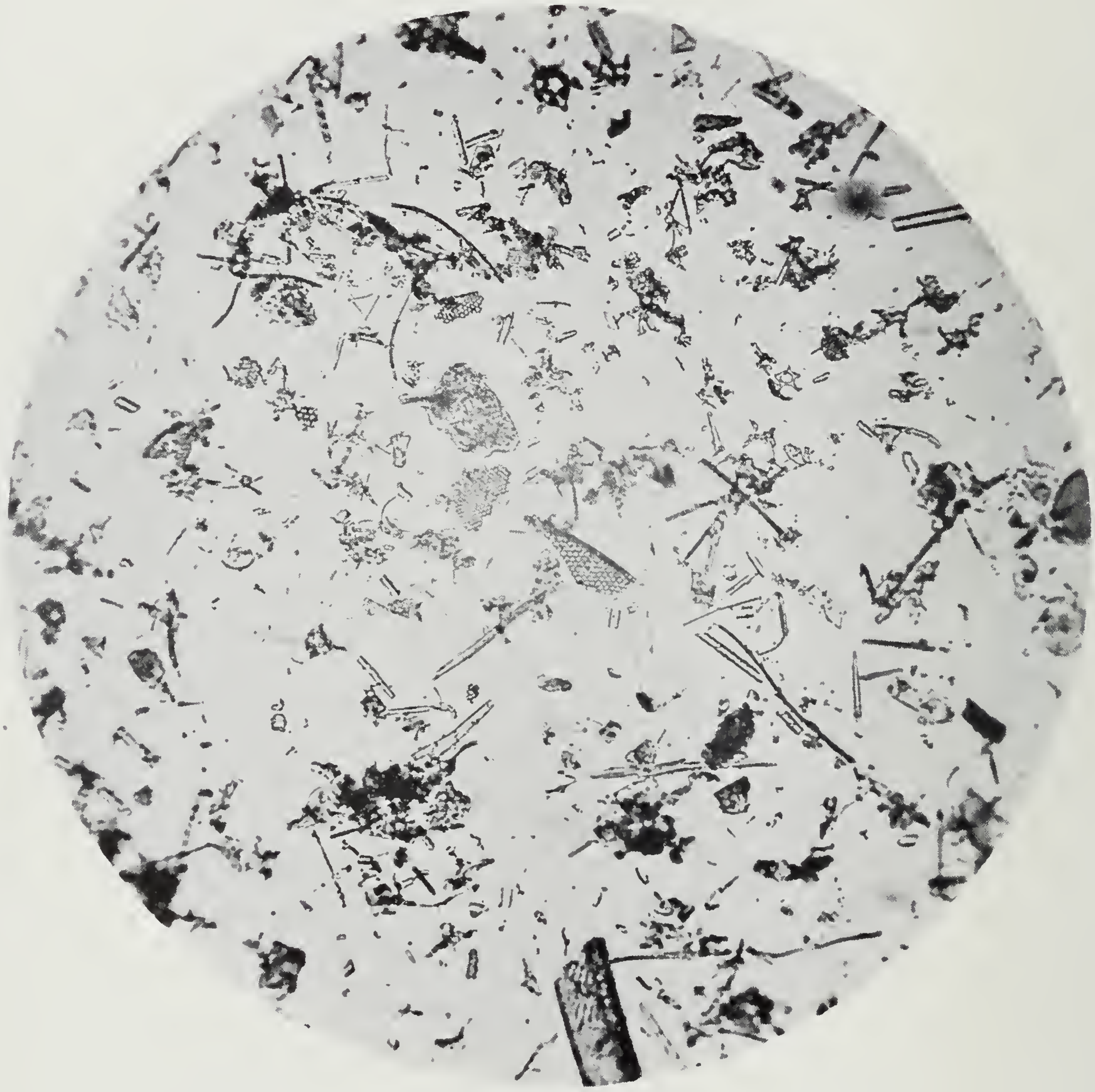

PHOTO NO. 22. Hyflo Super-Cel. Magnification 160X.

A small technical force, primarily interested in technical control, was established. The effects were immediately shown by a closer control of the milling and consequent improvement in products. Methods were evolved for milling and drying at the same time, and the wasteful method of air drying of crude became obsolete. Studies of milling and air separation produced extremely efficient blowers, cyclones, and dust collectors.

The two major calcined powders were planned and produced successfully to perform many filtrations more economically and to permit filtration of liquids unfilterable formerly. All new processes for milling were examined in great detail before being built into the various production systems.

The sawing of natural brick in the quarry was a result of considerable thought, as were the establishing of higher temperature insulating brick.

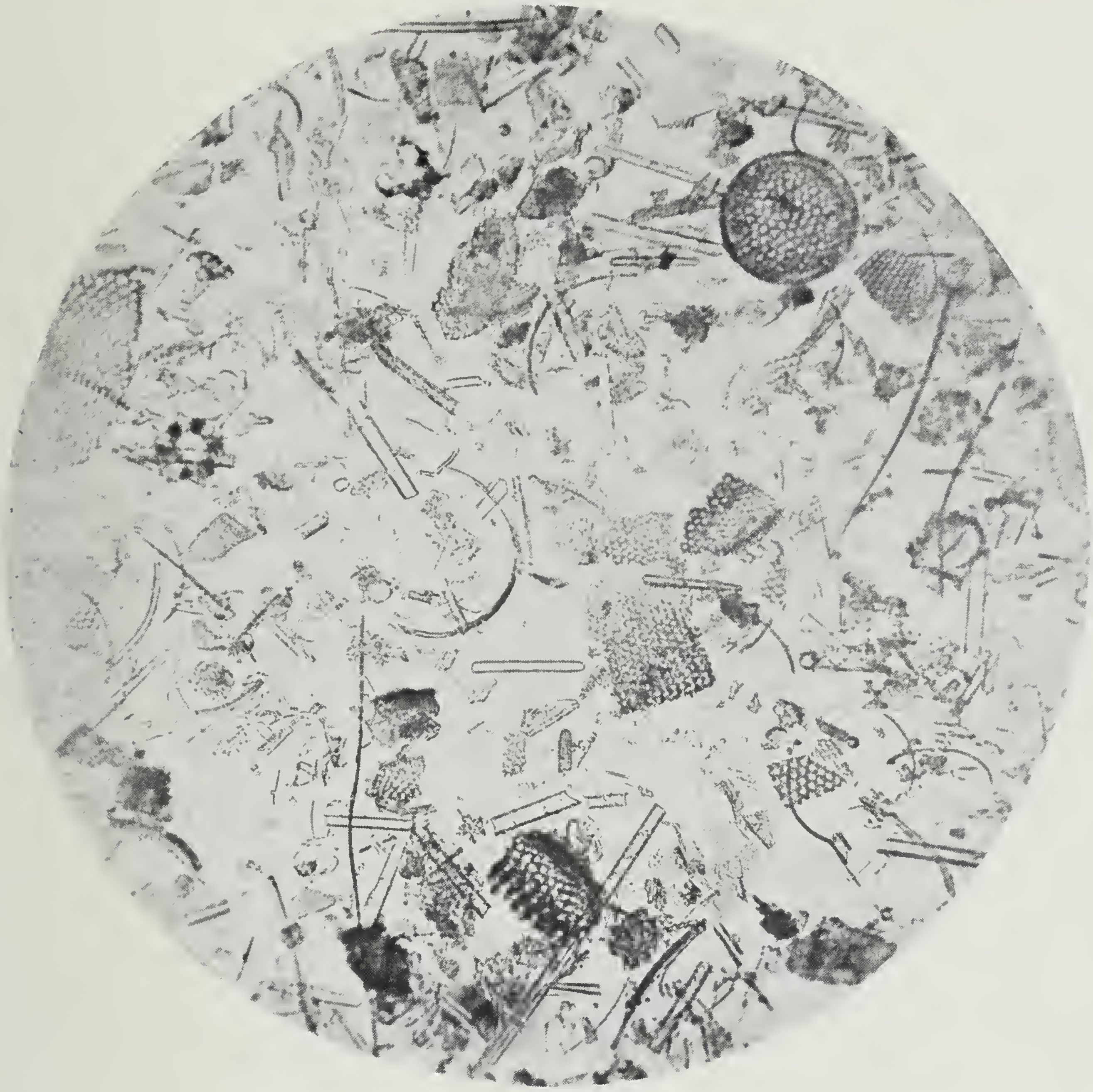

PHOTO NO. 23. Standard Super-Cel. Magnification 160X.

In 1928 the technical force at Lompoc numbered thirty. Departments had been created covering the inspection and control of finished products, geological control of the crude diatomite, research in admixtures for concrete, asphalt and rubber, research in matters pertaining to filtration problems of all kinds, research in insulation as brick, molded blocks, and powders, research in polishes, and research in milling and air-separation equipment.

Later, in 1929 Johns-Manville centralized its entire research staff at Manville, New Jersey, where elaborate laboratories were established for research work on all products manufactured by the corporation.

The Celite Research Department was then transferred to New Jersey, excepting for the section devoted to inspection and control and plant development which remains at Lompoc.

The development from crude milling to the highly improved milling and air separation now used and the great numbers of varied new uses are largely due to the efforts of the technical department.

Power and Fuel:

Electric power is transported by high-voltage lines from a substation in Lompoc and is furnished by the Midland Counties Public Service Corporation. Natural gas for drying and calcining is furnished by the Santa Maria Gas Company.

Maintenance

The deposit is so far away from large cities that it is necessary to have trained machinists, blacksmiths, carpenters and electricians, as well as a fully equipped machine shop at the plant.

Nearly all of the milling equipment is a result of local development, and so all cyclones, separators, blowers and crushers are manufactured at the plant. Maintenance on all equipment, buildings, roads, etc., is taken care of by this department.

Camp

There are 154 houses that have been erected in the hills close to the milling plant. They are primarily for the daily pay-roll men and their families, and are rented at a nominal fee per month. All are equipped with electric lights, running water, and in special cases natural gas. A large proportion of the employees avail themselves of the opportunity for low rent and proximity to the works. Others reside in Lompoc and commute to work by automobile.

A general store is maintained by private interests in the center of the main camp.

A school for the first six grades is located a short distance away in San Miguelito Canyon.

Hospital:

A fully equipped hospital is located in the main camp. It includes a sick bay, operating, and complete X-Ray equipment. Usually only first aid is rendered here, the more serious cases being removed at once to Santa Barbara or even Los Angeles.

Safety Work:

The company and its employees are safety conscious to a remarkable degree. A weekly inspection of all operating equipment is made by committees composed of three workmen and the leader in this work. The reports of these committees are carefully examined and faulty equipment, poor guards, or improper working conditions changed or corrected. The personnel of these committees is changed weekly.

Due chiefly to these weekly examinations by the workmen themselves and to the fact that the company immediately takes steps to remedy all faulty equipment and to place effective guards where needed, serious accidents are few, and minor accidents are maintained at a minimum.

ESSENTIALS IN DEVELOPING AND FINANCING A PROSPECT INTO A MINE[1]

By CHARLES WILL WRIGHT[2]

Foreword.

This paper will be of interest to those who are actually developing a mineral prospect or planning to do so, as well as to investors who are considering the problem of financing the development of the prospect, so that they may know what the risks are and what capital expenditures are necessary before a prospect may become a mine.

The term ''prospect'' used broadly, as it is in this paper, is defined as any property that has a mineral showing of sufficient interest to warrant development, irrespective of prior work. Such previous exploration, however, may be extensive and consist of several tunnels or adits connected by raises, or of shafts with several levels. There may also be a small mining and milling plant on the prospect which, because of the lack of capital for development or the lack of markets for the products, is now idle. Such prospects may warrant further capital investment for development work or for a mine plant to raise to the stage of profitable production.

The four essentials that go into the making of a mine are:

(1) A prospect with a persistent or continuous ore body favorable for the development of a sufficient tonnage of profitable ore and located within a reasonable distance from water supply and transportation facilities.

(2) Sufficient capital for development work and for the installation and operation of a mine and mill plant to make the property remunerative.

(3) A ready market for the product.

(4) Competent and efficient management.

All four are necessary for success, but the last is particularly important.

To develop a mine, it must first be financed through the prospect stage. The risk of capital investment is greatest during this stage, and failures often may be ascribed to the unwise use of the available capital rather than to lack of minable ore and to mining conditions. The advice and opinion of a competent mining engineer are essential in any mining venture but are of major importance in the development of a prospect. The chances of failure are reduced greatly by the application of sound financing on business principles and by placing a man in charge of the work who has had technical training and experience in mine management. The death rate among promising prospects is very high. Some engineers claim that less than 1 per cent of all prospects develop into profitable mines. All prospects, however, do not remain dead, and due to the stimulus of higher metal prices or improvements in metallurgical processes often are revived; sometimes these eventually become mines.

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[1] Reprinted from U. S. Bureau of Mines Information Circular 6839.
[2] Chief Engineer, Mining Division, U. S. Bureau of Mines.

Before starting to raise capital it is necessary to have a detailed report on the property prepared by a competent mining engineer. Unfortunately, this is done in exceptional cases only. Such a report should contain topographic and geologic maps, plans, and sections of the mine workings; assay records of the ore exposures, stating how samples were taken; and estimates of the tonnage and grade of ore developed,[3] the possible tonnage that may be developed by future exploration, and the cost of such development work. Information Circular 6748, Essentials for a Preliminary Report on a Small Lode-Gold Mine or Prospect, with Notes on Sampling, written by the author, was issued in October, 1933. Its object was to aid the owner of a small gold mine or prospect in preparing a report on his property for the purpose of interesting capital, but its essential features apply equally to ores other than gold.

Owners of small mines or prospects should prepare several copies of such a report, with illustrations and maps bound together. Fortified with information based on the data in such a report, they may then solicit financial aid. The investors, however, must know how much capital expenditure is required and justified and for what purposes it is to be used; and they also should have an estimate of the probable returns on the investment and when these may be expected. To make such an estimate is not an easy task, even for an experienced engineer, because there are so many unknown factors that have to be evaluated.

The object of this paper is to give to investors and mine owners a clearer conception of the risks they will encounter in attempting to make a mine out of a prospect and to point out the importance of geological studies, development work, tonnage estimates, mill tests, and management, as well as the market outlet and value of the product. Its purpose is also to point out to owners of a prospect the investors' viewpoint and ways to minimize risks to both owners and investors. Specific financing plans, providing enough capital to prepare the property for remunerative production over a period of years, are also important for its ultimate success.

In mining, as well as in other commercial enterprises, failure to anticipate capital requirements fully before productive operations are begun frequently has resulted in financial disaster to the enterprise. Thorough investigation and estimates of the ultimate cost of developing and equipping a property to the productive stage are therefore important before any major expenditure is started.

Importance of Geological Studies

Geological studies are necessary for determining the probable extent of an ore deposit, and one should have a clear conception of ore-forming processes before he makes estimates of ore reserves,[4] particularly as to the tonnage of probable[5] and possible[6] ore present. It is only when these natural processes are understood that assumptions may be made as to the continuity and uniformity of mineral content. From a miner's standpoint ore bodies may be grouped in four general classes:

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[3] Ore developed or blocked out is that accessible for measurement and sampling on at least 3 sides not over 150 feet apart in regular deposits. In irregular deposits the estimate is based more on an engineer's judgment than on mathematical calculations.

[4] Ore reserves are the estimated tonnage of ore to be mined.

[5] Probable ore includes those portions of the ore body that have been exposed on two sides, plus a small portion of the ore body beyond these sides.

[6] Possible ore includes areas within an ore body exposed on one side where ore may be reasonably expected to occur.

(1) Vein or lode deposits, where the ore minerals occupy a fissure or series of fissures in the country rock.

(2) Massive sulphide or replacement deposits, where the ore occurs in segregated masses, usually in limestone or in the vicinity of intrusive rocks.

(3) Disseminated deposits, consisting of sulphide minerals scattered through masses of either intrusive or sedimentary rock.

(4) Bedded deposits.

Where prospects are in known mining districts a study of the neighboring mines should be made to obtain all available knowledge of the habits and occurrence of minable ore[7] in the vicinity, the size, shape, and persistence in depth of the ore shoots, and the possibility of faults and their effect on continuity of the ore.

The country rock in which the ore deposit occurs and the type of deposit as well, are important factors in determining the persistence of the ore body. Deposits in limestone and along contacts of intrusive rocks[8] with limestone and other sedimentary rocks usually are irregular in shape, and the individual ore masses often are limited in extent but sometimes are very large. Inferences drawn from outcrops as to the form and size of such contact metamorphic deposits[9] are unreliable, and predictions of extension much beyond exposed faces are unsafe. Exploration of such deposits should be confined to the borders of the intrusive rocks, except where a pronounced mineral zone extends outward from the intrusive masses.

Careful study of the occurrence of ore shoots[10] within a mineral zone or a vein or lode is also important in planning developments. Ore shoots may be distinguished by the presence of certain minerals or their relationship to geological features. Some occur where cross-fractures intersect a mineral zone or vein, others where the vein itself is strongly fractured or where there are vugs or cavities in the vein. Anticlines or synclines[11] in sedimentary rocks[12] are often favorable points for deposition of ore, and the proximity of dikes may also be indicative.

Most nonferrous metalliferous deposits occur in dsitricts of abundant igneous[13] intrusive rock, and the ore bodies often are found close to the contacts of the intrusive masses. In certain areas it has been observed that fingerlike extensions from large masses of intrusive rocks point to the places where the ore bodies occur. In other instances they occur where the intruded rocks form embayments in the line of contact.

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[7] Minable ore is ore which will yield a profit under normal conditions.

[8] Intrusive rocks are those rock masses or dikes that have been pushed up into the bedded rock, such as granite and porphyry.

[9] Contact metamorphic deposits are those that occur in the altered rock areas between the intrusive rock masses and bedded rocks.

[10] Ore shoots are portions of a vein or ore body carrying high-grade or paying ore.

[11] An anticline is an arch or fold of rock strata bulging upward, while a syncline is a U-shaped fold.

[12] Sedimentary rocks are composed of material derived from the erosion or decay of other rocks.

[13] Igneous rocks are those consolidated from a molten state; they include both volcanic and intrusive rocks.

The proximity of an ore body where limestone is the enclosing rock sometimes is indicated by dolomitization[14] of the limestone, a change that may extend a considerable distance from the ore body. Where shales or schists enclose the ore bodies there is often a silicification[15] of the wall rocks, and the rock near the ore bodies is of a lighter color or appears to have been bleached.

A trained geologist will observe numerous chemical and structural characteristics. From these observations, together with a carefully prepared geological map of the area where the ore bodies occur, interpretations may be made which are of utmost importance in planning the future development of an ore body. The new edition of Ore Deposits, by W. Lindgren,[16] presents clearly the value of geological studies, and The Principle of Economic Geology, by W. H. Emmons,[17] gives an excellent discussion of all kinds and types of ore bodies and their formation.

Certain types of ore deposits are more continuous than others. The vein and lode deposits are the most persistent, and predictions often can be made with some degree of certainty as to the continuity of ore between known points for deposits of this type. However, it is seldom safe to gage the size of a treatment plant by information based on estimated tonnages of possible ore in ore bodies which have been exposed on one side only or opened by a single tunnel or drift.[18]

Often the metal content of an ore deposit depends upon whether it has been subjected to secondary enrichment.[19] In northern glaciated regions primary ores usually extend to the surface, and oxidation with secondary enrichment is unimportant. In dry climates, where erosion has been less, time has allowed extensive decomposition of the ore bodies near the surface, and part of their metal content has been carried in solution and deposited at lower levels. As the extent of this secondary enrichment varies greatly with depth and as the metal content of the ore is not uniform, estimates of possible ore beyond known limits are highly speculative. It is therefore necessary to recognize secondary enrichment and to determine by exploration whether valuable ore may exist below the ore exposed and whether the enriched ore will be succeeded in depth by workable primary ore.[20]

Well-defined fissure veins that are exposed for a thousand feet or more along the surface would be expected to continue for several hundred feet in depth, under normal conditions, unless they are cut off by some structural feature in the enclosing rocks that is not apparent from the surface. Such structural terminations may be caused by a sudden pinching or closing of the fissure in which the vein occurs or by a fault displacing the ore body, beyond which its extension is uncertain.

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[14] Dolomitization is the change from limestone to dolomite caused by an impregnation of carbonate of magnesium into the limestone, forming a calcium magnesium carbonate.

[15] Silicification is caused by the penetration of solutions carrying silica and depositing this silica in the rocks adjacent to the fissures in which ore may occur.

[16] Lindgren, W., Ore Deposits, 4th ed.

[17] Emmons, W. H., The Principles of Economic Geology: McGraw-Hill Book Co., New York, N. Y.

[18] The term "tunnel" is used commonly instead of adit or drift, although if strictly interpreted a tunnel is an opening extending entirely through a hill, but in mining literature and among mining men a tunnel is a passageway into a hill.

[19] Secondary enrichment of a vein or an ore body is an enrichment by material of later origin, usually derived from the oxidation of decomposed, overlying ore masses.

[20] Primary ores are those first or originally formed in an ore deposit before alteration began.

Examples

(1) A deposit of copper ore in southeastern Alaska, which occurred on a mountain divide at the contact of a granite mass with limestone, was partly explored by trenches and short tunnels. Due to oxidation of the sulphide deposit, malachite, azurite, and limonite were formed, and these surface minerals were spread over a wide area, giving the appearance of a large deposit. Instead of sinking a shaft to determine the depth of the deposits a tunnel 2000 feet long was driven to develop the deposit at a depth of 600 feet. Meanwhile an aerial ropeway, smelter, and wharf were built. No ore was disclosed by the tunnel, and later the deposit was bottomed by a shaft at less than a hundred feet below the surface. Had the shaft been sunk in the ore at the start or a tunnel driven 100 feet below the outcrop about a million dollars in useless expenditure would have been saved. Moreover, examination of the other copper deposits in this area would have shown that this type of ore body was limited in lateral and vertical extent and secondary enrichment confined to within a hundred feet of the surface.

(2) A vein deposit of lead ore in sericite schist had been developed and mined over a length of 3000 feet above the adit level. A shaft was sunk 200 feet, and at a depth of 100 feet a level was opened up for a length of 1000 feet; this showed the vein to be wider and just as rich as on the upper level. Estimates were made of probable and possible ore down to and below the 200-foot level, and based on these estimates a new mill and power plant were built. The 200-foot level was started in ore, but a pinch in the vein, which extended the entire length of the vein between the 100- and 200-foot levels, was encountered a short distance from the shaft. Winzes were sunk below the 100-foot level at several points until the pinch was found. Exploration below the 200-foot level failed to disclose the extension of the vein below the pinch. Based upon the assumptions made and upon normal conditions for this type of deposit the capital expenditure would have been recovered, but the example shows that speculations on estimates of possible ore are hazardous.

Importance of Geophysical Prospecting Methods

Geophysics has been a valuable aid in many instances in exploration of mineral deposits. Both electrical resistivity methods and the magnetometer have been used extensively in tracing the extension of ore veins and faults and in determining subterranean geological features that affect the occurrence of minerals. It is, however, no easy matter to interpret the results of the field survey, and to do so usually requires a thorough knowledge of geology. At most, these surveys can show only certain anomalies within an area that will correspond to those caused by an ore body, a fault, or some geological characteristic in a known area and thus indicate a favorable place for exploration. It is therefore most important to use more than one geophysical method within an area, so that the geophysicist may be prepared to check the interpretation of the data and to make detailed geological studies before he begins costly underground explorations. Geophysical methods also are used to check geological deductions and supplement them, and in any extensive mine development the use of these methods should be considered.

Importance of Development Work

Misguided and insufficient exploration of the ore bodies is often the reason for failure to make a mine out of a prospect or to make a mine a profitable producer over a period of years. Lack of capital frequently prevents owners or operators of small mines from extending development work unless they can do so out of profits from the ore. To make a salable product may require a milling plant, the expenditure for which, based on the ore exposed, may or may not be justifiable. However, the desire to produce, not only by the operator but by those who have financed the initial development work on the prospect, spurs them to put up more capital for unwarranted expenditures on plants in the hope of quick return rather than to use this capital for essential development work. No expenditure on a treatment plant is justifiable until a suffiicent tonnage of ore is developed to return the capital expenditure out of profits from the ore reserves. There are also many cases of failure where the tonnage of ore developed is ample, but the owner has wasted his capital on machinery or equipment purchased without adequate knowledge of requirement.

The owner of a prospect should realize that an examining engineer is particularly interested in the tonnage of ore exposed and the prospective profits to be derived from this ore. He therefore should concentrate upon exposing and blocking out ore in the most promising portion of the deposit and should extend exploration to find the continuation of this deposit or additional deposits. An ore deposit may have merit, even though only a small tonnage is exposed. Although the owner may have faith in what future development will show a competent examining engineer knows the risks of making assumptions, and rather than take such risks he will turn down the undeveloped prospect. Of the prospects examined by engineers it is estimated that only about 1 per cent are reported upon favorably, the reason frequently being the lack of tonnage developed or unreasonable price or terms rather than low assay values.

Methods of Development

The topography of the surface and the type of the ore deposit are usually the deciding factors in planning the development of a mineral prospect.

To determine the most advantageous way to develop an ore body one should have good topographic maps of the surface, and on this the trenches, tunnels, drifts, and shafts along the ore deposits should be indicated. Where underground development work has been extensive a plan and vertical sections of the workings are essential guides in planning further work. The position of the ore body, as well as faults, dikes, and other geologic features, should be indicated on these mine plans and sections.

Surface Explorations

Surface exploration of any ore deposit should be carried on as extensively as possible, because this is usually the cheapest way to get information. A vein or other type of ore body should be located by cross-trenching at intervals and then exposed by stripping along its strike, if possible. Where the overburden is not too deep for such work a series of trenches usually is dug at regular intervals, at right angles to the strike. The distance between trenches is determined by the type of ore body and the depth of the soil; trenches should be close enough to determine the average width of the ore body and to avoid missing ore shoots and to permit proper sampling of the ore. Trenches over ore shoots are spaced more closely than over barren areas. Where good ore is found test pits are made to permit sampling well below the surface. Usually a vein or ore body will show in a general way the same variations in size and values along the surface as will occur in depth, although there are many exceptions.

Underground development in flat areas requires vertical or inclined shafts, from which drifts are extended along the vein or ore body, while in mountainous areas development often is carried on by a series of tunnels at different levels. The size and number of the shafts or tunnels will depend upon the daily tonnage to be extracted. Where large tonnages are to be mined provision should be made for underground storage bins and loading pockets.

Tunnels, Drifts, and Crosscuts

In a mountainous country it usually is possible to open up a vein or ore body by a drift or tunnel along the vein or by a crosscut to intersect the vein or ore body and then by drifts to develop it along its strike. The advantages of developing an ore deposit from a tunnel or adit compared to shaft-sinking are obvious. A tunnel is the cheapest method; as the workings are self-drained, no machinery is required for hoisting, haulage costs are lower than those for hoisting over the same distance, and the cost of tunneling or drifting is usually about one-third that for sinking a shaft.

Shafts

Veins or other types of deposits coming to the surface may be developed by: (1) Inclined shafts following the ore body as nearly as possible along its dip either in the ore body or in the footwall, (2) vertical shafts adjacent to the ore body with crosscuts to the deposit, (3) a combination of vertical and inclined shafts or of a tunnel and a shaft.

The advantages of an inclined shaft are that it is kept in or close to the ore, thus avoiding crosscuts and permitting development of the vein by drifts in the ore in two directions, while the ore taken out may pay part of the development expense.

The advantages of the vertical shaft are: (1) Hoisting is faster, there is less wear on the hoisting rope, safety devices may be applied more efficiently, no pillars of ore are required for protection, except in passing through veins or deposits, and water can be bailed or pumped out more easily.

Shaft sinking is the most costly form of development work, but in some instances is the only type possible. In the development of vein deposits inclined shafts are sunk, usually following the vein or in the footwall of the vein, and are to be recommended for new developments. The inconvenience of hoisting in an inclined shaft usually is not serious enough to justify sinking a vertical shaft in country rock. The cost of a prospect shaft ranges from $7 to $60 per foot, depending on size, depth, and rock. Numerous examples, with detailed costs and speed of sinking, are given in Bulletin 357, Shaft-Sinking Practices and

Costs, by E. D. Gardner and J. F. Johnson; Information Circular 6800, Mining and Milling Practices at Small Gold Mines, by E. D. Gardner and C. H. Johnson; Bulletin 381, Lead and Zinc Mining and Milling in the United States, Current Practices and Costs, by Chas. F. Jackson, John B. Knaebel, and C. A. Wright; and Bulletin 363, Gold Mining and Milling in the United States and Canada, by C. F. Jackson and J. B. Knaebel.

Mine Levels

Whatever the method of entry into an ore body, mine levels or drifts, as well as cross-cuts, are necessary to develop the vein or ore deposit laterally. Starting from the shaft the intervals between these mine levels usually range from 100 to 200 feet. The question of the economic interval between mine levels is discussed at length in Information Circular 6613, Factors Governing the Selection of the Proper Level Interval in Underground Mines, by William O. Vanderburg.

Drifts are extended at these level intervals along the ore body, which is prepared for stoping by raises and chutes. These raises are spaced according to the shape of the deposit to permit the extraction of the ore with the least amount of handling as well as purpose of ventilation. The cost of drifting and crosscutting varies from $2 to $20 a foot, the average cost being about $6.00. For raises the cost per foot may be slightly less. Direct cost of hand-drilling is about the same as with power drills, except in very hard rock. The progress, however, with an equal number of men working is only about one-third as fast as with power drills.

Attention given to the position of a development drift in ore with reference to the walls of the vein or ore deposit will be of value when ore above the drift is stoped. If the vein is quite steep, the drift may be run equally well with the vein on either side, or in the middle. If the vein dips 60 degrees or less it is more convenient to have the drift in such a position that the stope floor will intersect the side of the drift high enough to install chutes for loading a car or a bucket.[21]

Usually there is no difference in the size or shape of drifts and crosscuts. Crosscuts in general require less timber than drifts, because the country rock away from the ore zone usually is less fractured and altered and is therefore stronger.

Numerous examples and detailed costs of drifting and crosscutting are given in the series of papers on mining methods and costs during the last few years by the Bureau of Mines and in the Mining Engineers Handbook, by Robert Peele.

Sampling and Exploration by Means of Hammer Drills

For underground sampling and exploration of ore deposits, light hammer drills, using unjointed bars of steel, are used widely as a means of determining the presence or the width of ore bodies 5 to 20 feet beyond the existing faces. The cuttings from such holes are collected and assayed, and the grade of the ore is calculated on the basis of the assays from these drill-hole samples. Fairly reliable results thus may be obtained at a low cost, and often parallel veins or lenses of ore have thus been discovered which otherwise would have been missed. Deep-hole drilling with heavy hammer-type machines and sectional steel frequently is used for holes up to 500 feet that are horizontal or inclined up to a 30-degree angle. The sludge is collected for the sample. In southeast Missouri, using a heavy Leyner-type machine, holes 35 to 78 feet were drilled at a contract labor cost of 16 cents per foot, according to Knaebel.[22] It is generally assumed that the "deep-hole" method is less expensive than diamond drilling, but for holes over 100 feet long the cost per foot with the new light diamond-drill outfits is not much greater than drilling deep holes. One has the advantage of speed and a core of the country rock as well as the ore which for purposes of correlation are better than sludge samples.

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[21] Jackson, Chas. F., and Knaebel, J. B., Underground Chute Gates in Metal Mines: Inf. Cir. 6495, Bureau of Mines, 1931, 22 pp.

Diamond Drilling

The object of diamond drilling is to outline known ore bodies and to prospect outlying areas, to block out ore reserves and guide mine developments. The diamond-drill core is a representative sample of the ore and rock traversed and may be assayed to determine the metal content of the ore and studied to determine the geological relations of the rock.

Diamond-drill cores range in diameter from 1 inch to 2 inches, according to the depth of the hole, and the machines are operated by compressed air, gasoline, electric or steam power. The water required is 60 to 110 gallons per hour, of which there is about 25 per cent loss, if all water returns to the collar of the drill hole and the overflow from the sludge box can be reused. A consumption of 60 to 70 barrels a day is an average for deep-drilling outfits. The drilling speed ranges from 1 foot to 8 feet an hour actual drilling time, which is 25 to 50 per cent of the total time. The cost of drilling is $2.00 to $6.00 a foot, with some records below $2.00 and many instances where the costs were over $6.00.

As diamond drilling requires specialists to obtain the best results the work usually is done on contract, except at large mines with trained crews for the work.[23] [24]

Shot Drilling

Shot drills, which use steel shot in place of diamonds in core drilling, are used extensively in sampling bedded deposits from the surface. The advantages of the shot over the diamond drill are its ability to bore holes of large diameter and the low cost of the abrasives of the bit; moreover, less experience is required of operators. The average speed for a $3\frac{1}{8}$- to 5-inch core in average rock is 1 foot per hour. Shot drilling is limited to downward holes from 45 degrees to vertical. Shot-drill holes may cost more per foot than diamond-drill holes due to the higher power consumption. For more specific data the reader is referred to the catalogue of the Calyx Shot Drill Co. and to pages 391 to 393 of the Mining Engineers Handbook, by Robert Peele.

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[22] Knaebel, John B., Sampling and Exploration by Means of Hammer Drills: Inf. Circ. 6594, Bureau of Mines, 1932, 29 pp.

[23] Peele, Robert, Mining Engineers Handbook: 2d ed., John Wiley & Sons (Inc.), New York, 1927, pp. 373–400.

[24] Hansen, Mayor G., Diamond Drilling at the United Verde Mine: Inf. Circ. 6708, Bureau of Mines, 1933.

Churn Drilling

Where vertical holes from the surface are required these can be made with a churn drill. Such holes usually are 6 inches in diameter; when drilling is done in solid rock the speed is 1 to 2 feet on hour and the cost $0.50 to $6.00 per foot, with a probable average of about $2.50.[25]

Sampling and Tonnage Estimation of Ore Deposits

The basis for any investment in a prospect are the average assay values of the ore and the tonnage of ore developed. The importance of getting and properly presenting such information often is not realized by the owner until he attempts to interest capital in developing his property. Bureau of Mines Bulletin 356, also Information Circular 6748, and the Mining Engineers Handbook describe in detail the standard methods of ore sampling and making tonnage estimates.[26]

The regular deposits in which the valuable minerals are distributed uniformly are the simplest type to sample by the ordinary drill or channel sampling methods and sampling becomes increasingly difficult with more erratic mineralization. In veins containing precious metals irregularly distributed there is the question of rejecting pieces of visable metal in the sample or discarding the exceptionally high sample assays in making up the averages. The size of sample to be cut and the sample interval are also important considerations and depend upon the distribution of the ore minerals in the gangue. The more uneven this distribution is, the larger the size of the sample and the smaller the interval between samples in order to obtain satisfactory results. The mineralization in some ore deposits is so erratic that only by a large tonnage mill test can the average grade of the ore be determined.

In making tonnage estimates certain assumptions have to be made regarding the continuity and grade of ore between exposed and sampled openings and extensions of ore beyond exposed ore faces. The accuracy of the estimates will depend to a large extent upon the experience, integrity and soundness of judgment of the engineer responsible for them.

Tonnage estimates are usually classified under three separate headings: "Developed ore," "Probable ore," and "Possible ore." Developed ore is usually ore, the continuity and grade of which have been proved on four, or at least three, sides not over 150 feet apart, and allowances should be made for loss in mining and dilution with waste. Probable ore includes the portions of the orebody that are exposed on two sides plus small additional portions beyond these sides, but here, too, the engineer must limit himself to certain conservative distances for extensions of ore beyond exposed faces. In estimating possible ore more latitude may be taken in deciding the limits of the ore occurrence beyond the known facts but these limits must be based on logical geological criteria or interpretation.

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[25] Peele, Robert, Mining Engineers Handbook: 2d ed., John Wiley & Sons (Inc.), New York, 1927, pp. 356–366.

[26] Jackson, Chas. F., and Knaebel, J. B., Sampling and Estimation of Ore Deposits: Bull. 356, Bureau of Mines, 1932, 155 pp.

Wright, Charles Will, Essentials for a Preliminary Report on a Small Lode-Gold Mine or Prospect, with Notes on Sampling: Inf. Circ. 6748, Bureau of Mines, 1933, 12 pp.

Peele, Robert, Mining Engineers Handbook: 2d ed., John Wiley & Sons (Inc.), New York, 1927, pp. 1845–1964.

Mining Methods and Costs

The features that influence the choice of mining methods are size, shape, and dip of the ore body, continuity in depth and length, regularity of ore boundaries, strength of ore and wall rocks, grade of ore and distribution of metal contents, structural irregularities, faults, slips, joints, and fracture zones. In the usual type of vein deposit where the wall rock as well as the ore is fairly solid the open stope or cut-and-fill methods are in most common use. If the walls are not strong enough, then stulls or square-sets are used, often followed by filling. All these methods permit sorting of ore in the stopes and selective mining. The shrinkage and caving and sublevel-stoping methods are applied to large, low-grade deposits for large-scale or wholesale mining.

Large production requires large ore bodies and large initial investment in development and preparations. Where such operations are contemplated the problems of safety, good ventilation, and continuity of flow of ore from the stopes to the cars, taking the utmost advantage of gravity, are of prime importance for low-cost operation.

Mining conditions being the same, a narrow (2- to 3-foot) vein will cost twice as much per ton to mine as a vein 6 to 8 feet wide, but if the vein is 10 to 20 feet wide the mining cost will be only slightly less than that of a 6-foot vein.

The advantages and disadvantages of the different mining methods and comparative results at a large number of mines in the consumption of man-hours, explosives, power, and supplies per ton mined, are given in Information Circular 6503,[27] by the author.

The following tables are taken from this paper:

AVERAGE RESULTS FOR DIFFERENT MINING METHODS, 1929 FIGURES

Mining method	Man-hours per ton, all underground labor	Tons per man-shift, all underground labor	Explosive used per ton, pounds	Power, kw. hr. per ton	Total underground cost per ton
Square-set	5.15	1.553	1.363	34.9	$4.825
Average of	61 mines	61 mines	10 mines	19 mines	11 mines
Cut-and-fill	4.34	1.843	.660	10.045	$3.076
Average of	21 mines	21 mines	5 mines	4 mines	5 mines
Shrinkage	1.33	6.015	1.656	15.33	$2.682
Average of	37 mines	37 mines	18 mines	16 mines	16 mines
Open-stope	1.17	6.837	.844	8.90	$1.250
Average of	170 mines	170 mines	22 mines	17 mines	19 mines
Sublevel caving	.95	8.421	.605	13.00	$1.438
Average of	17 mines	17 mines	4 mines	2 mines	2 mines
Top slicing	.932	8.584	.520	7.252	$1.208
Average of	37 mines	37 mines	13 mines	12 mines	3 mines
Caving	.628	12.739	.244	3.0	.516
Average of	7 mines	7 mines	3 mines	3 mines	4 mines
Surface					
Opencut	.324	24.691	.308	2.71	.309
Average of	55 mines	55 mines	3 mines	3 mines	3 mines

The following table shows roughly the relative consumption of labor, explosives, and power, according to the metal mined; the number of mines from which the data were obtained is indicated in each case. With data from more mines and for a period of years, these averages would be more representative.

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[27] Wright, Charles Will, Mining Methods and Costs at Metal Mines of the United States: Inf. Circ. 6503, Bureau of Mines, 1931, 39 pp.

LABOR, EXPLOSIVES, AND POWER CONSUMPTION IN METAL MINES

Metal	Man-hours per ton mined	Man-hours per unit of product	Explosives, pound per ton mined	Power kw. hr. per ton
Iron underground	1.14 (94 mines)	2.35 (tons) (94 mines)	0.548 (30 mines)	8.38 (30 mines)
Iron opencut	.39 (48 mines)	.82 (tons) (48 mines)	----------	----------
Copper underground	1.63 (63 mines)	.046 (lb.) (63 mines)	.439 (10 mines)	7.64 (10 mines)
Copper opencut	.29 (7 mines)	.014 (lb.) (7 mines)	.308 (3 mines)	2.71 (3 mines)
Lead and zinc	2.01 (161 mines)	.022 (lb.) (161 mines)	.920 (15 mines)	17.65 (15 mines)
Gold	1.27 (31 mines)	6.41 (oz.) (31 mines)	.844 (8 mines)	9.72 (8 mines)

Underground Mining Problems

Underground problems include drilling and blasting practice, underground support, mechanical loading, mine transportation, ventilation, drainage, and safety. The following are some of the Bureau of Mines publications on these subjects that may interest mine operators.

Bull. 306—Crane, W. R., Mining Methods and Practice in the Michigan Copper Mines: 1929, 192 pp.

Bull. 311—Gardner, E. D., Drilling and Blasting in Metal-Mine Drifts and Crosscuts: 1929, 170 pp.

Bull. 330—McElroy, G. E., Ventilation of the Large Copper Mines of Arizona: 1930, 145 pp.

Manuscript Report 1—Jackson, Chas. F., Underground Scraping Practice in Metal Mines: 1934.

I. C. 6086—McElroy, G. E., Why, When, and How to Make a Ventilation Survey of Metal Mines: 1928, 12 pp.

I. C. 6326—Jackson, Chas. F., Some Notes on Underground Transportation: 1931, 40 pp.

I. C. 6382—McElroy, G. E., Mine Ventilation in the Coeur d'Alene District, Idaho: 1931, 37 pp.

I. C. 6495—Jackson, C. F., and Knaebel, J. B., Underground Chute Gates in Metal Mines: 1931, 22 pp.

I. C. 6501—Crane, W. R., Essential Factors Influencing Subsidence and Ground Movement: 1931, 14 pp.

I. C. 6651—Crane, W. R., Abstracts of Recent Articles on Mine Support: 1932, 23 pp.

Initial Mine Plants

The machinery required to do the development work will depend upon the development plan and capital available. Where capital is limited many ingenious, inexpensive devices are used to operate compressors, hoists, pumps, and haulage equipment. It is usually possible to buy second-hand machinery, such as oil or gasoline-driven air compressors, rock drills, hoists, pumps, mine cars, and track and electrical dynamos and motors at about half the cost of new machinery. The question of transporting machinery to a prospect must also be considered, and the size and weight of individual pieces should conform to the available means of transport. Foundations and housing are also to be added to the cost estimates for the plant, and good construction is important for the plant. Besides the housing for the mechanical equipment, quarters for workmen, a change house, boarding house, and warehouse, a carpenter and machine shop and assay office may be necessary as work progresses. The question of a year-round water supply for mining, milling, and domestic purposes is important.

In making estimates for the cost of a mine plant, one should refer to Peele's Handbook of Mining and to catalogs of manufacturers of mining machinery. The following papers, issued by the Bureau of Mines, on costs of equipping mines also contain specific information on individual operations as well as valuable suggestions for those contemplating new mine developments and plant installations:

(1) I. C. 6591—Reigart, John R., The Cost of Developing to the Operating Stage and Equipping a Small or Medium-Sized Mine in the Tri-State Lead and Zinc District: 1932, 18 pp.
(2) I. C. 6601—Sweet, J. R., Mining Methods and Costs at the Mt. Hope Mine of the Warren Foundry and Pipe Corporation, Mt. Hope, N. J.: 1932, 31 pp.
(3) I. C. 6674—Howes, G. A., and Jackson, Chas. F., Shaft-Sinking Methods and Costs, and Cost of Plant and Equipment at the Macassa Mine, Kirkland Lake, Ontario: 1932, 10 pp.
(4) I. C. 6681—Keast, A. J., and Jackson, Chas. F., Method and Cost of Exploring, Equipping for Development, and Developing the Central Patricia Group of Claims, Northern Ontario: 1933, 13 pp.
(5) I. C. 6693—Jackson, Chas. F., Some Notes on Methods and Costs of Equipping and Developing Prospects: 1933, 24 pp.
(6) I. C. 6707—Emens, W. H., and Jackson, Chas. F., Methods and Costs of Developing and Equipping the Ashley Gold Mine, Matachewan Gold District, Ontario: 1933, 28 pp.
(7) I. C. 6730—Sweeney, E. L., Design, Equipment, and Construction Costs of the Davis-Dunkirk Concentrator, Prescott, Ariz.: 1933, 5 pp.

Importance of Mill Tests

The method of treatment for the ore must be known before a mine can be valued, as its net value depends upon the percentage of metal that can be recovered economically and the cost of recovery. Where concentrates are sold to a smelter not only will there be further metal losses, but deductions will be made for deleterious or undesirable elements, besides the smelting charges. It is important to know what these deductions and charges will be.

For properties that have been in operation, these factors are known, but for newly developed properties it usually is necessary to have a large-scale mill test preceded by laboratory tests to determine the method to be used for the large test. Such tests require 1 to 100 tons of average-grade ore and the cost at commercial testing plants will range from $500 to $5,000. If ore of similar character is being treated within the district the mill results from these plants should be obtained and their flow sheets studied.

Trouble has been experienced with many small properties due to faulty design and construction of milling plants based upon inadequate and inconclusive tests for determining the best flow sheet. In other instances, 100 to 200-ton mills have been erected where a 25-ton mill might have brought the prospect into production. The matter of getting the right advice is highly important, and the time one needs good advice is before starting to build a mill. The United States Bureau of Mines and the State mining bureaus and colleges are sources for information on methods of ore treatment. The textbook by Arthur F. Taggart, Ore Dressing, is another good source, and valuable information may be obtained in Robert Peele's Mining Engineer's Handbook.

Cost of Milling Plants

The cost of a mill will vary according to the nature of the ore and the method of treatment required. A flotation or amalgamation mill will cost $500 to $800, multiplied by the number of tons the mill will treat in 24 hours. Where well-constructed buildings are necessary in northern districts the cost is higher than in southern districts, where lighter construction suffices. The total cost of mills for complex ores, where two or more methods of ore treatment are combined in one plant, and for an all-slime cyaniding plant will be $1,000 to $1,500 per ton capacity in 24 hours.

Just what treatment is required depends upon the character of the ore to be milled, and it is often necessary to work out a flow sheet for the treatment of an ore using a combination of methods to get a high recovery. As most mill plants undergo changes in their flow sheet or system of ore treatment it is better to begin with a pilot plant of 10 to 20 tons capacity per 24 hours rather than to erect a 100 to 200-ton mill. Such procedure will give more time to iron out difficulties in the milling problems and to develop the mine. It may be found that a mill of only 50 tons per day capacity is large enough instead of a previously contemplated plant for 200 tons. There are many failures on record where capital has been spent on large-capacity mills for small-capacity mines, whereas the mine might have been successful with a small mill. In some instances the reason for this is the urgent demand of the investors or shareholders for profits before the mine is ready for production on a profitable basis.

Milling Costs

Milling costs range from 25 cents to as high as $10 per ton, depending upon the capacity of the mill, the methods of treatment used, and the ability of the mine to keep the mill running at full capacity. Shutdowns due to lack of ore or to mechanical troubles all increase the costs, and these are more serious for a mill with large capital investment than for a small one. Overhead expenses, such as administration, amortization, taxes, insurance, and interest all run 24 hours a day, and the mill should do likewise.

Details of milling costs for the different methods of ore treatment and size of plants as well as the cost of plant construction are given in the handbooks referred to by Taggart and Peele; for individual operations reference is made to the following papers on small mill plants:

(1) I. C. 6430—Blackburn, W. H., Milling Methods and Costs at the Lead-Zinc Concentrator of the Treadwall Yukon Co., Ltd., at Tybo, Nev.: 1931, 14 pp.
(2) I. C. 6447—Vanderburg, Wm. O., Milling Methods at the Hughesville Concentrator of the St. Joseph Lead Co., Hughesville, Mont.: 1931, 15 pp.
(3) I. C. 6476—Woodworth, Selim E., Milling Methods and Costs at the Argonaut Mill, Jackson, Calif.: 1931, 12 pp.
(4) I. C. 6497—Andrus, D. E., Milling Methods and Costs at the Montana Mine Concentrator of the Eagle-Picher Lead Co., Ruby, Ariz.: 1931, 14 pp.
(5) I. C. 6508—Dixon, John, Milling Practice of the Kirkland Lake Gold Mines (Ltd.), Kirkland Lake, Ontario: 1931, 13 pp.
(6) I. C. 6541—Redington, John, Milling Methods and Costs of the Coniaurum Mines (Ltd.), Schumacher, Ontario: 1931, 5 pp.
(7) I. C. 6730—Sweeney, E. L., Design, Equipment, and Construction Costs of the Davis-Dunkirk Concentrator, Prescott, Ariz.: 1933, 5 pp.
(8) I. C. 6739—Bean, J. J., Milling Methods at the Oxide Concentrator of the International Smelting Co., Tooele, Utah: 1934, 18 pp.

Investigation of Placer Mines

E. D. Gardner, in part I of Placer Mining in the Western United States (Inf. Circ. 6786) says:

> "Failure to sample and estimate properly the available yardage of placer deposits has resulted in a tremendous waste of money and effort. A large proportion of all placer operations has failed because the gold in the gravel was insufficient to repay the cost of even the most efficient mining, not to mention the return of money invested or interest thereon.

Many methods of sampling are available, including the simple panning of gravel from natural exposures, drifting, test-pitting or trenching, shaft-sinking, and churn-drilling. Actual mining on a small scale often is done as a method of sampling prior to investing considerable money in development or equipment.

A gravel deposit of much size seldom can be sampled directly from its natural exposures; but a few creek banks, steep-sided gulches, or old excavations such as hydraulic pits may be available, in which case certain precautions should be taken to get true samples. First, the vertical extent of gravel to include in a given sample should be determined. If hydraulicking is to be done, the whole depth of gravel ordinarily is included in one sample, except when it is planned to pipe off the barren overburden to waste, in which event it is desirable to know the depth of barren material and samples may be taken of each distinguishable stratum. If drifting is planned, only the lower, economically minable gravel need be sampled. After the location and extent of a sample cut have been decided, care must be taken to have equal quantities of gravel from all points along its length. The best way to do this is to cut a channel or groove of uniform shape and size from top to bottom of the sample distance. Enough such samples must be taken to prove the continuity of the 'pay streak.'

Shaft sinking is the usual method of testing placer ground. Prospect and sampling shafts, unless intended for later use in drifting or mining and unless exceptionally deep (75 feet or more), are sunk as small as practicable. The usual section is rectangular and in most districts is commonly used to crib shafts in loose gravel. In gravel tight enough to stand safely without lagging the only timber necessary is stulls set to hold the ladder.

In river flats sub-surface waters usually prevent extending a shaft to bedrock, and in such instances drive-pipe sampling is the only solution.

The sampling of placer deposits by drilling, or, more precisely, drive-pipe sampling, is discussed in detail by Janin.[28] He states that the Keystone No. 3 traction machine is used generally in California. The usual casing is 6 inches inside diameter and ⅜-inch thick, in 5– to 7–foot sections. Drilling without casing is not good practice, and high values in a hole so drilled can not be accepted. The bit and stem weigh 800 to 1,000 pounds. The cutting shoe usually is about 7½ inches in outside diameter. Theoretically this dimension is the diameter of the cylinder of material excavated, hence it determines the yardage per foot of hole drilled. A sand pump is used to lift the loosened gravel or sludge from the hole, usually after each foot of drilling when in pay dirt. The casing is driven ahead of the tools except when boulders or cemented gravel prevent. The casing is recovered after finishing the hole.

Regardless of the method used, the samples taken from each foot or several feet of drilling usually is treated in a rocker, and the concentrates are panned to recover the gold. The colors are classified by eye according to size, usually into three groups, and a record is made of the number of each. Generally the gold is then amalgamated with a small quantity of mercury, which at the completion of the hole is dissolved in nitric acid. The gold is then weighed to give the total yield of the hole. Frequently the tailings from rocking and panning are saved and reconcentrated at the completion of the hole to detect and recover gold lost during the first washing.

The value of gravel in cents per cubic yard equals weight of gold recovered in milligrams times value of gold in cents per milligram times the conversion factor 27 (cubic feet per cubic yard), divided by the depth drilled in feet times the cross-sectional area of the hole, or briefly,

$$\text{V (cents per yard)} = \frac{\text{weight of gold (mg)} \times 0.06 \times 27}{\text{depth drilled (feet)} \times 0.3068}$$

As an aid in determining the depth of placer deposits, geophysical prospecting methods have been applied successfully in many instances. Where the bedrock is of homogeneous or uniform magnetic permeability and where considerable magnetite is associated with valuable gold concentrations, magnetometer surveys can outline these leads quite accurately.[29] The instruments used most for this purpose are the Thompson-Thalen, Askania and Hotchkiss magnetometers, which measure slight changes in the intensity of the earth's magnetic field. Operation of these instruments is not difficult, but correct interpretation of the results requires experience.

Where uniform bedrock conditions do not exist the magnetic work must be supplemented with electrical work to obtain complementary data for use in interpreting the magnetic anomalies. The electrical work gives information on thickness of gravel and depth to bedrock, contour and outline of the underlying bedrock, and other structural features which may be of value in planning the mining operations.

It must be emphasized that no geophysical method or combination of methods is offered by reputable engineers as a means for determining the commercial value of placer-gold deposits. However, information gained by geophysical methods as to the physical features of the deposit are of great value both in subsequent testing and in developing and operating the property.

Apart from the deposit itself, the water supply is the most important factor in determining the application of hydraulicking and the scale of operation. Under any given conditions the daily yardage is roughly proportional to the quantity of water used. The quantity excavated likewise is proportional to the head used on the giants, but the higher pressure is of less value in driving and washing and of none at all in sluicing the gravel through the boxes to the dump. As the cutting and sweeping capacity of the giants usually exceeds the carrying capacity of water a stream of flowing water, known as 'by-wash', or 'bank water', is directed through the pit and into the sluices.

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[28] Janin, Charles, Gold Dredging in the United States: Bull. 127, Bureau of Mines, 1918, pp. 30–49.

[29] Laylander, K. C., Magnetometric Surveying as an Aid in Exploring Placer Ground: Eng. and Min. Jour., vol. 121, Feb. 20, 1927, pp. 325–328.

The preparatory or development work necessary to start hydraulicking usually is greater than that for any other form of placer mining except dredging or drift mining. A deposit peferably is opened at the lower end to permit gravity drainage and progressive mining of the entire deposit in an orderly fashion.

A single mine may have many miles of ditch, costing perhaps $2,500 per mile, as well as dams and reservoirs and thousands of feet of flumes, tunnels, or inverted siphons. The mechanical equipment of a hydraulic mine ordinarily consists of a few hundred to a few thousand feet of 10– to 30–inch, or larger, iron pipe, one or more monitors, and a varying number of sluice boxes; the cost of equipment ordinarily is small compared to the expenditures necessary for ditches and tail races.

Although it is obvious that the recoverable gold content of the gravel must pay a profit over operating costs, which usually range from 5 to 20 cents per yard, a surprising number of ventures in hydraulicking have failed because the promoters have not allowed for all the preparatory expenses noted above. Each yard of gravel mined must carry its share of this cost, therefore the size of the deposit is of utmost importance in considering a hydraulic mining venture.

Hydraulicking under suitable conditions is a low-cost method as it yields a larger production per man-shift than any other method except dredging. The initial investment required is less than that for dredging; hence, hydraulicking in small or medium-sized deposits may be more economical even though dredging would result in a lower operating cost. When the operations are on a very large scale hydraulicking costs are lower than dredging costs on a comparable basis. Very clayey or bouldery gravels should be hydraulicked as dredging usually is unsatisfactory in such ground."

To determine the profits from placer deposits of known yardage and value is a simpler and, one might say, a safer undertaking than estimating profits from vein or lode deposits. Costs depend upon the method to be used, water supply, and yardage to be treated per shift. Costs as low as 4 cents per cubic yard are being obtained in dredging and hydraulic operations and as low as 10 cents in drag-line operations, but they are often many times higher.

It is of utmost importance that those intending to finance a placer property have it examined and sampled by a competent placer-mining engineer rather than base their estimates and plans of operation on reports prepared by the owner of the property. The increased interest in gold mining has attracted many operators experienced in sand and gravel operations who may have idle equipment and inventors with "trick" gold-saving machinery who wish to test their devices. These men, inexperienced in placer mining, fully believe that all that is necessary is to find a placer deposit and get capital to start operations. They induce their friends to help finance their ventures or promote a company for public subscription. Nearly all such attempts have been unsuccessful; they have failed principally because the yield from the placer deposit was less than was anticipated and the operating costs higher than estimated.

In any placer-mining undertaking it is advisable to use only standard equipment which has been proved to be the simplest and most satisfactory.

Gardner, in the information circulars mentioned, presents a number of tables giving cost data and other information on a number of placer mines classified according to the method of operation. The reader is also referred to the reports by the State mining bureaus and to the following publications:

Janin, Charles, Gold Dredging in the United States: Bull. 127, Bureau of Mines, 1918, 226 pp.

Wilson, E. B., Hydraulic and Placer Mining: John Wiley & Sons, New York, 1918.

Wimmler, Norman L., Placer-Mining Methods and Costs in Alaska: Bull. 259, Bureau of Mines, 1927, 236 pp.

Boericke, W. F., Prospecting and Operating Small Gold Placers: John Wiley & Sons, Inc., New York.

Gardner, E. D., and Johnson, C. H., Placer Mining in the Western States:
Part I—General Information on Shoveling and Ground Sluicing: Inf. Circ. 6786, 1934, 73 pp.
Part II—Hydraulicking, Treatment of Placer Concentrates and Marketing of Gold: Inf. Circ. 6787, 1934, 89 pp.
Part III—Dredging and Other Forms of Mechanical Handling of Gravel and Drift Mining: Inf. Circ. 6788, 1935, 81 pp.
von Bernewitz, M. W., Handbook for Prospectors: McGraw-Hill Publishing Co., Inc., New York.

Importance of Market Studies

As the gross profit from mining operations is the market or selling price of the product minus production and transportation costs one must consider with greatest care what the future average prices for the metal to be mined probably will be. Such an estimate not only takes into account past price averages but what future demands may be for the product under consideration and what the competitive mineral products are and their selling prices. One must also consider the other sources of supply of the product, the production costs at these sources, and their proximity to the markets.

Thus far there always has been a market for gold, and the prices of other metals are based on the relative value of gold. The last decade, however, has shown what variations may occur in metal prices, as well as in other mineral commodities. The following table shows some of these changes:

AVERAGE PRICE, CENTS PER POUND (NEW YORK PRICES)

Metal	1911-20	1921-30	1931	1932	1933	1934
Copper	18.9	14.1	9.1	6.3	6.4	8.53
Lead	5.8	6.5	3.7	3.0	3.9	3.86
Zinc	8.4	6.3	3.8	3.0	4.0	4.51

The low prices during the last few years are no more the real prices of the metal than are the highest prices during the preceding years.

One may well ask what price should be taken for a metal or other mineral commodity in making estimates that may be regarded as safe. There are many publications that present the price curves for the metals, some going back for over 100 years, and by studying these price curves and taking into account what has been already mentioned a forecast of probable future prices may be made.

Importance of Competent Technical Advice and Efficient Mine Management

During the past two years the Bureau has collected records of over 1000 gold mines, old ones reopened and new ones developed by newly organized companies. A detailed study of the field notes indicates that only a small percentage of these operations by newly organized companies were successful, was due to three things: Insufficient tonnage of profitable ore, inexperienced or poor management, or inadequate financing. Quotations from Bureau of Mines engineers' field reports will illustrate this point.

W. O. Vanderburg, in a letter dated June 2, 1933, wrote as follows:

> I believe that 95 per cent of the small mines visited are being operated by men who were honest. This was contrary to what I expected to find, although it

must be admitted that in many cases the operators are not getting the most for the money spent. One major criticism in the small-mine field is the building of mills before sufficient ore has been developed to justify their erection. The plan followed in many instances is to build the mill first and then start looking for ore. In some cases after the mill was built the operator had no funds available for development work. Another common fault in the small gold mine field was the lack of planning in underground development. Very few of the mines had maps of any sort of the underground workings.

In a letter dated June 10, 1934, E. D. Gardner stated:

> It is surprising to see the number of old gold properties that have been opened up by men from other lines of business. One day last week, I visited six mines in one locality. One was being operated by a building contractor from Kansas, another by a manufacturer from Chicago, a third by an electric furnace man from Pittsburgh, and so on. The sixth was managed by a so-called engineer. I doubt his mining ability, however, as he had five surface men servicing two men in the hole. The electric furnace man was building a furnace to smelt his concentrates which he may or may not make.
>
> It is beyond all understanding why people who have been successful in non-engineering lines feel so confident they can operate a gold mine successfully. In some cases, if the money holds out long enough they learn enough to get by. In others there is not enough money in the world for them to become educated in mining. In practically all small gold operations, management or supervision consists of two-thirds finding the ore and one-third getting it out.

If the prospective mine operator would engage a competent mining engineer to advise him at the start rather than after an unsuccessful attempt to develop a mine the number of failures would be less. The question of management can not be overemphasized, as so much depends upon the judicious expenditure of each dollar. A manager should not be picked because he will accept the job for half the salary of a more experienced man, as new mines can not afford to pay for the mistakes of the inexperienced. The ability of a manager to get the most out of the men under him is another important qualification.

A paper by the author on Management of Labor in Successful Metal-Mine Operations (Inf. Circ. 6650), which was published by the Bureau of Mines in August, 1932, presents the problem encountered in the development of efficient mine organizations and shows the methods used by certain mining companies in promoting efficiency.

A mine manager must know human nature and use tact in dealing with personnel problems, both with the staff and with the workmen. He must have the ability to devise ways and means of reducing costs and must exert influence over the entire organization so that both staff and workmen will endeavor to promote the company's interest. Above all, he must be an engineer with years of mining experience and of unquestioned integrity.

Managers of small mines, like many operators of small industrial companies, do not always recognize the value of accurate accounting control over their operations. To meet this situation, Bulletin 372, Accounting System and Office-Management Procedure for Medium-Size Metal Mines, by A. E. Keller, has recently been issued by the Bureau of Mines.

Mine Financing

It is essential that any set-up for financing a mine should be submitted to and discussed with a competent lawyer who is familiar with state corporation and mining laws, taxes, and the various plans for the registration and issue of securities. Clear titles to the property to be financed are also essential, and the questions of water rights, disposal of tailings, mill sites, and railroad sidings solved where necessary before extensive developments are undertaken.

For small groups, where little capital is required, partnerships or syndicates often are formed. In these partnerships or syndicates a single member may be held responsible for the full amount of any indebtedness against the property, regardless of the amount of his interest. To eliminate this responsibility of the individual, stock companies are formed, which may issue assessable or nonassessable stock.

The advantage of a company with assessable stock is to permit mining operations to be started with a small initial capital. When more capital is required this is raised by an assessment and those who can not or do not wish to pay the assessment may sell their stock or their stock may be debited to the amount of the assessment until sold. Another advantage is that small stockholders can not be frozen out, as may be done when companies with nonassessable stock reorganize or liquidate.

The advantage of a company with fully paid nonassessable stock is that it is more easily sold to the public, and the owner is free from any liability. In such a company it is important to make ample provision for all capital requirements at the start, as it is only possible to acquire capital later through a loan or the sale of a new issue of stock, which can not always be done.

Because of the numerous worthless mine promotions and dishonest mine promoters both the investor in mine stock and owner of a prospect are strongly advised to get reliable information on the companies in which stock is offered and the men who wish to promote a new company to acquire capital for the development of a prospect. There are many instances where the property owner has turned over his rights in exchange for stock certificates only to find that the money acquired through the sale of the company's stock has gone into the pockets of the promoters and not into mine developments. Both the public and property owners are protected to some extent in certain states by "blue-sky laws" and recently by the Securities Exchange Commission, but even with these safeguards the greatest caution should be exercised before an interest in a mine is purchased or sold.

Evaluating a Prospect

The prospective investor (not speculator) is interested in the answers to two questions: (1) How much net profit is there in the blocked out ore, and (2) what chance has the prospect to make a mine? The first question can be answered quite accurately after the ore deposit has been sampled carefully and production costs determined, but one can not express in figures the chance of finding more ore. If the value of a prospect is the net profit on the ore exposed few of them will be found to be worthy of capital investment.

To make a mine, an ore body must be of sufficient size and grade to repay all investment in purchase, development work, and plants, besides all costs of production and interest on capital. If an owner has spent years on his property he often has too optimistic an opinion of its immediate value, and in presenting his prospect for sale he does not always appreciate the necessity for the investor to have a detailed report on the property, with title abstracts, maps, inventories, and (what is of greatest importance) detailed estimates of the tonnage and grade of ore developed. The prospective buyer must have all of this information and much more to be in position to judge the value of the prospect. Good prospects often are not considered, because this information is lacking. If, however, the investors are ready to send an engineer to make an examination they will first wish to have an option. The owner is thus obliged to place a value on the prospect. Those who will provide capital for development are becoming more willing to send engineers to examine prospects, provided the preliminary information is complete and the price reasonable; but they are not willing to pay for development of a prospect unless it has an exceptional showing. This readiness to devote the services of engineers and geologists and to risk their money in the examination and exploration of a property within a specific time limit should be a sufficient guarantee of good faith to the owner. Investors today also expect the owner to have enough faith in his property to be willing to accept payments out of production rather than to insist on large initial cash payments.

Requirements for Obtaining Capital

When it comes to a question of financing, the company or individual to whom the proposal is made will require the following information:

(1) Names and addresses of present as well as former owners of property.
(2) Copies of title record and description of claims or parcels as given in office of recorder.
(3) If property is held under partnership, copy of agreement, or if held under lease, copy of lease.
(4) Complete statement of any mortgages or indebtedness against the property.
(5) Copies of available reports made by engineers or geologists.
(6) Copies of available topographic and geologic maps of the district and a description of the geology of the district.
(7) A recent engineer's report on the property which should include:
    (a) A description of the method used in sampling and name and address of the assayer.
    (b) Detailed estimates of ore blocked out and assay results.
    (c) Estimates of probable and possible ore reserves and supporting data.
    (d) Detailed description of the surface and underground workings and their present condition or accessibility.
    (e) Inventory of the buildings, plants, and equipment on the property.
    (f) Copies of laboratory tests or mill tests of the ore if any have been made.
    (g) Records of any ore shipments that may have been made, together with assays, results, and payments.
    (h) Information on source, kind, and amount of water supply and nature of water rights; on power supply and cost; on timber supply and costs; on labor supply and wage scale; on housing and living conditions; on transportation facilities and costs; distance to nearest railroad; conditions of roads; and all other information that may help in an estimation of production costs.

Arrangements for Obtaining Capital

Formerly the price demanded for a prospect varied with the locality of the prospect and the mental attitude or financial standing of the owners. Some property owners were modest and demanded only a nominal sum in cash, while others felt they should have the full value of ore blocked out or even more in cash. Cash sales often were made regardless of value during boom periods, and some purchasers succeeded in realizing a profit. Today owners find it difficult to get even a small cash payment for their property on which they have invested their small fortunes. Investors usually are unwilling to put up cash except for the development work and insist that owners accept a share of eventual returns from mine production for their property.

In the light of the uncertainties inherent in mining, probably the method of financing which is fairest to owners and investors alike is the leasing system, in which the investors agree to furnish funds to develop the property and to pay an agreed royalty on each ton of ore obtained. The lease may be written with or without an option to purchase at a stated price at the end of the leasing period. Such an arrangement indicates that an owner has enough faith in the value of his prospect to be willing to share the risk with the investor. However, in many cases owners have sunk all their capital in prospects and must make a quick sale for cash on which to live. In other words, they have already gambled and feel it only fair that the investors should also gamble to carry on. In such case, an initial cash payment equal to the amount expended by the owners may be justified. On the other hand, the owners may know nothing of mining but feel that their prospects have market values, because they have been shown to contain ore. They may have had numerous offers to lease but remain skeptical that the lessees intend to do their utmost to make the property productive. They may feel that the lessees wish merely to tie the property up for such time as will enable them to dispose of it to a third party. For these reasons owners often make unreasonable demands for an immediate sale involving an initial cash payment to be followed by regular bonded installments. It is for this reason that many promising prospects lie idle. If owners were willing and able to cooperate with legitimate investors in permitting the latter to give the prospect a fair trial. their chance of remunerative returns would be enhanced.

Information Circular 6774, Leasing System as Applied to Metal Mines, by W. O. Vanderburg, published by the Bureau of Mines in April, 1934, gives a clear presentation of the leasing system. In it the bond and lease and straight lease are discussed, the advantages and disadvantages to both the lessor and lessee are presented, the terms or elements for drawing up a lease are given, and the amount of royalties to be paid for various conditions are suggested.

In the leasing system the royalty represents the division of the profit on the ore produced. It is to the advantage of both parties to the contract to make an equitable adjustment of royalty payments. High royalties put a premium on gouging for higher-grade ores and decrease the lessees' incentive to do exploration work. Leasing contracts usually stipulate certain agreements which insure a minimum amount of work or plant installation to make the property productive. By leasing, property owners deal more fairly with lessees than by demanding cash payments, as the risk on investment is minimized. In a straight lease, paying royalty alone, money that would otherwise go to making payments in the face of uncertain conditions may be used for mining purposes.

Mine owners or lessors should stipulate a time limit, granting the privilege of an extension if terms agreed upon are fulfilled; if not, the lease becomes null and void.

THE GOLD-BEARING VEINS OF MEADOW LAKE DISTRICT, NEVADA COUNTY

By A. L. Wisker [a]

Introductory

The following report deals generally with the auriferous veins of Meadow Lake Mining District, Nevada County, California, but relates particularly to 18 claims delineated on the map which accompanies it. Together these form a connected block which includes the principal mines in the heart of this district. Four are patented claims, the remainder being held by location under U. S. mining laws. In early days the area in question was the scene of nine separate operating enterprises. It is now planned to consolidate all these properties into one mine, susceptible of development through one general system of works, that the economies of large-scale operation may be realized. As recorded, these claims are designated Excelsior No. 1, Excelsior No. 2, Union No. 1, Union No. 2, Of What No. 1, Of What No. 2, Wotell, Lake, Blue Fox, New Hope, Mammoth, North Mammoth, Dam End, Fraction, Great Eastern, Great Western, Great Western Extension, and C.B.C.

* * * * * * *

Any engineer who endeavors to accurately set forth the conditions relative to the extensive mineral deposits of this long-neglected and almost forgotten mining camp faces a difficult task. Since the early '70s the only work done in the district has been on a small scale, desultory, intermittent, and without system or intelligent direction. No underground work worthy of the name has been done for more than 30 years, and all save a few shallow workings are full of water or are more or less inaccessible from caving. Such ore faces as are accessible for sampling are those left when the properties closed down, and certainly are not up to the average grade encountered when the mines were operating.

If systematic records were ever kept during the years of peak activity (1865–1872) they were not preserved; and such records as were made during the last period of mine operation (1901–1905) were burned in a fire at the Excelsior Mine subsequent to 1915.

In the ''Report of the State Mineralogist'' for 1924, page 356, the following statement occurs in an article on ''Meadow Lake District,'' by C. A. Logan, district engineer, California State Mining Bureau:

> "In spite of the great amount of work done, there has never been any adequate report upon the mines of the district; and it is hard to get an idea of the characteristics of the deposits or the extent of development of any of the claims from any literature accessible to the general public. Only brief mention is found in state and government publications."

During the past three years my search through files of publications covering a period of more than 30 years has brought to light hundreds of informative references to this little-known mining camp. With allowances for exaggeration and inaccuracy, this material has been most useful. Further information has been found in histories of Nevada County (Bean, 1868; Thompson & West, 1880). I have been fortunate in having access to several reports on the Excelsior mine, and to correspondence written by Henry H. Hartley, discoverer of the Meadow Lake veins and first owner and small-scale operator for nearly 30 years of

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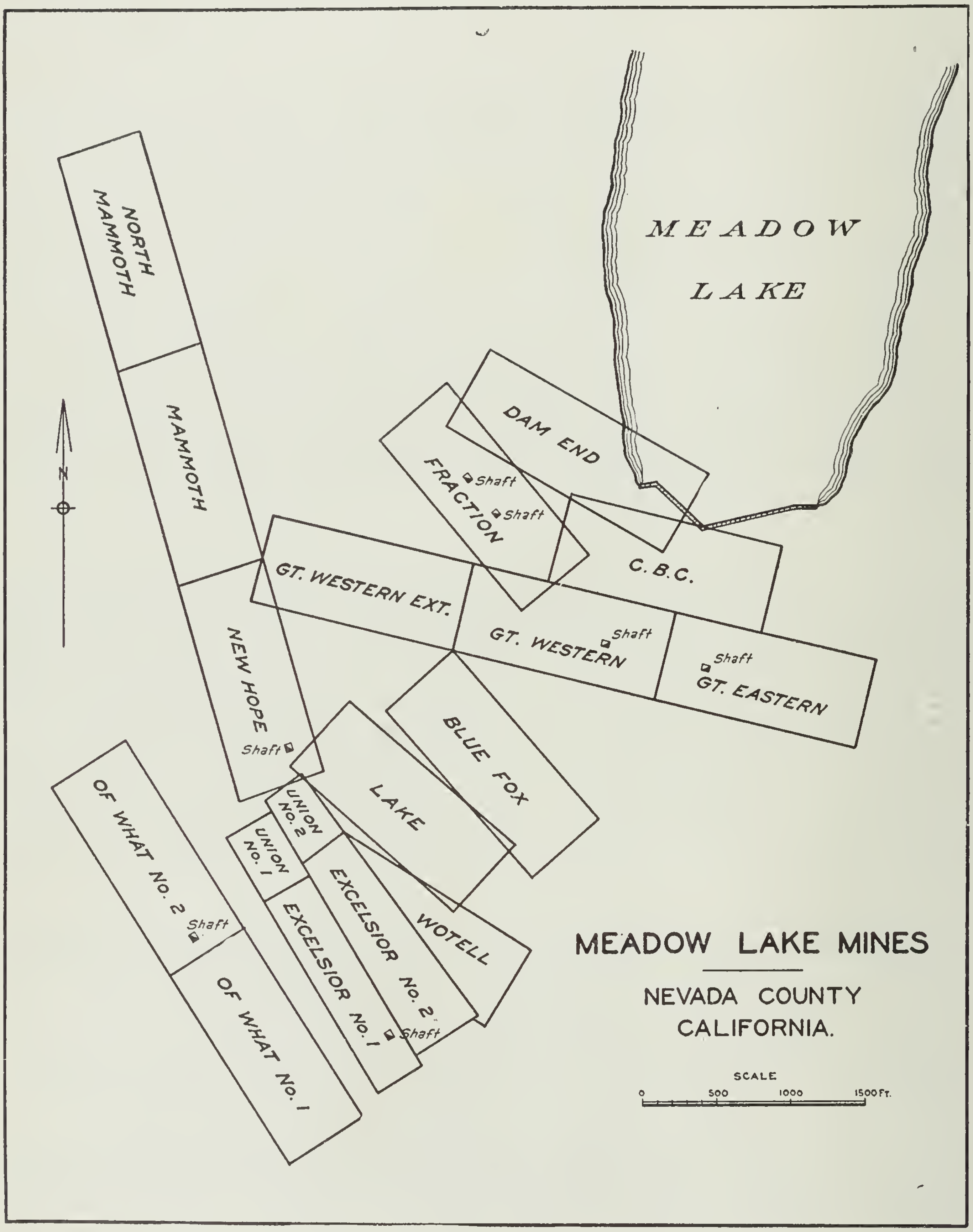
[a] Mining Engineer, San Francisco.


MEADOW
LAKE
NORTH MAMMOTH
MAMMOTH
N
DAM END
FRACTION
Shaft
Shaft
C.B.C.
GT. WESTERN EXT.
GT. WESTERN
Shaft
Shaft
GT. EASTERN
NEW HOPE
Shaft
BLUE FOX
LAKE
UNION No. 2
UNION No. 1
OF WHAT No. 2
Shaft
EXCELSIOR No. 2
Shaft
WOTELL
EXCELSIOR No. 1
OF WHAT No. 1
MEADOW LAKE MINES
NEVADA COUNTY
CALIFORNIA.
SCALE
0
500
1000
1500 FT.

the Excelsior group. Some of this material dates back 50 years. As a whole it has never been available to any other engineer. For the past three seasons I have spent the larger part of each summer at Meadow Lake, and have made a leisurely and intensive study of the geology and mineralogy of the ore deposits of its extensive mineralized area, which I have as yet not covered in full. There are other mining properties of interest and of merit in addition to those discussed herein, although the 18 claims responsible for my investigation appear to constitute the most important portion of the mineral belt.

Because of the paucity of information concerning this forgotten field of early-day mining activity, and because of the improbability of all the data available to me ever becoming available to others, brevity has been sacrificed in the preparation of this report and all pertinent information has been incorporated. For such value as it may have to the mining industry of the State in a historical sense, I have placed a copy with the State Mineralogist of California for public reference.

Early History

The first recorded discovery of gold and the earliest mining locations were made in 1863 by Henry H. Hartley on claims now known as the Excelsior mine.

Nearly a mile distant, on the western shore of Meadow Lake, surrounded by gentle, timber-crowned slopes, the pioneers built the town of Meadow Lake in 1865, incorporated it in 1866, practically abandoned it by 1872. At the zenith of its growth Meadow Lake numbered its population at several thousand. It had its weekly paper, thirteen hotels, two theaters, a brewery, a bank, a stock exchange—and even a church—beside the usual aggregation of stores, saloons and dives common to all mining camps.

Today Meadow Lake is but a memory—it is not even a ghost town. A line of crumbling, rotten boards faintly outlines its once-bustling main street. The location of the largest hotel, the stock exchange, and a few other buildings may still be identified by piles of rotted lumber, flattened to earth by the heavy winters, deep snow being always experienced at that altitude—7250 feet. A sheepherder's shack and a prospector's cabin, built in later days, are the only structures now to be found at the site of this once-famous mining camp, today all but forgotten. Of all who were in 1866 a part of the hectic life of this highest "City of the Sierras" none live today, so far as known.

The scene of a wild stampede and mining excitement in 1865, the meteoric existence of Meadow Lake ended with its virtual abandonment in the early '70s, although a few indomitable souls, with unshaken faith, clung to the old camp for many years in spite of multiple discouragements and oft-repeated failures. One of the hardiest of these was Hartley, discoverer of the district and original locator of the Excelsior mine, by which name the district was first known. Not until 1865 did Hartley's discovery attract much notice in mining circles, but in that year the district was the mining sensation of the West. One of the first newspaper accounts, taken from the San Francisco Mining and Scientific Press of July 1, 1865, is as follows:

> "Much excitement has been created in Nevada County, in this state, and in Virginia City and vicinity, about the discovery of a rich series of ledges in Nevada County on the Henness Pass route. * * * According to the Union (Virginia City) it is well wooded and watered, a heavy growth of magnificent timber covering the entire district. * * * A town has been laid out, and a toll road located and surveyed from Webber's. * * * The district has been named Excelsior, and it is claimed that it will eclipse anything in the way of croppings yet discovered. The main ledge is traced five miles, for which distance every foot of it is located. * * * The excitement is great and every claim located is being worked, all having the greatest confidence in the great wealth of the ledge, which it is supposed will pay from the surface down, for the croppings assay from $9,000 to $61,000 to the ton. The lowest assay yet obtained is $65. * * * The width of the ledge, so far as ascertained, the deepest shaft on it being only 41 feet, is from 6 to 12 feet."

Except in the one matter of values the description is quite accurate, and small quantities of specimen ore undoubtedly gave a foundation of fact to the values stated.

* * * * * * *

Location

Meadow Lake (formerly Excelsior) mining district is about 35 miles easterly from Grass Valley and eight miles north from Cisco, a small station on the Southern Pacific 186 miles east of San Francisco. It is practically at the summit of the Sierra Nevada Range.

Accessibility and Transportation

Meadow Lake is reached by auto road from Truckee, via Hobart Mills and Webber Lake, distance 37 miles. The roads are only fair dirt roads but the grades are moderate and no difficulty would be experienced in trucking in supplies. Eventually the old stage road of the '60s to Cisco, now impassable for the last two miles, might be reconstructed, reducing the distance to less than 10 miles. A landing field for airplanes at the old townsite would involve but a small expense. In winter, the heavy snows would close all roads except to caterpillar tractor travel.

Climate

The general altitude is around 7100 feet at these mines, an elevation productive of deep snows. At the townsite the snow has reached a depth of 12 to 18 feet in severe winters and seven to eight in the mildest. During the remainder of the year the climate is delightful. Occasionally the winter temperature drops below zero. By stocking sufficient supplies in the fall all-year work may go on without interruption.

Timber, Water and Power

Abundant timber (yellow pine, lodge-pole pine and red fir) is close at hand, and the sawmills of the Hobart Mills Lumber Company are 30 miles distant over a fair road for trucking. A local mill would be an economy if large quantities of timber were required underground—a contingency which appears unlikely in view of the hardness of both walls and the vein material.

Water for mine, mill and domestic use by gravity flow may be obtained from Meadow Lake by arrangement with Pacific Gas & Electric Company, and about 250 hydraulic horsepower could be uniformly developed from the same source. Unlimited electric power can be bought from the company, whose transmission line is less than six miles distant.

Geology and Mineralogy

The principal formation of the Meadow Lake area is mapped as granodiorite by the U. S. Geological Survey. It is generally more finely-crystalline than the granodiorite which forms the walls of several of the famous mines of the Grass Valley area. Most of the Meadow Lake veins are in the granodiorite; but, as at Grass Valley, some occur in diabase and some pass from the latter into the former without noticeable effect. Waldemar Lindgren, for the U. S. G. S., visited this region in 1892. He considers the granodiorite the more recent of the two rocks.

The granodiorite occurs as a batholith of moderate dimensions, extending northwesterly and southeasterly and flanked on the east by diabase and recent eruptive rocks. The mines under consideration occur near the easterly margin of the batholith but veins of importance are found as much as 6000 feet west of this margin.

Lindgren has classified the Meadow Lake ore deposits as fissure veins belonging to the hypothermal or deep-seated zone. They appear to represent a transitional type between gold-quartz and copper-tourmaline deposits, and partake of the nature of both.

There are two major vein systems, the strongest (typified by the Excelsior vein, 4 to 50 ft. wide) having a general surface course about N. 25° W. The more numerous and smaller veins of the other system (2 to 15 ft. wide) vary between N. 45° W. and N. 85° W. On their northerly course there is apparent convergence toward the Excelsior vein system. Probably some unite with it, coming in from the footwall side, and possibly forming wide orebodies contiguous to junctions. Seemingly none cross it, and none were observed converging toward the Excelsior from the hanging wall, although there are parallel veins on that side. A major fracture is suggested, with branch fractures departing from the footwall, extending southeasterly, affording the fissures along which solutions and magmatic emanations have deposited minerals, by replacement and other processes.

The general dip of all veins is to the southwest at an angle of from 55° to 80°. Rarely a vertical dip or a northeasterly dip at a high angle is noted, but unquestionably the permanent dip of all veins will be to the southwest and at an angle high enough to favorably affect stoping the ore.

In the U. S. G. S. folios of the Truckee and Colfax quadrangles Lindgren refers to certain veins as not being "well defined." In his article, "Auriferous Veins of Meadow Lake," Mining and Scientific Press, February 24, 1894, page 118, he refers to the veins generally as having a vertical dip "or at high angles to the northeast." As stated above, an occasional northeast dip has been observed, and it is also true that some minor veins near the Meadow Lake dam are none too well defined. Applied to the major veins both his observations are incorrect and in conflict with the facts, hence it may be assumed that this excellent geologist had opportunity for but a superficial study of this region.

The major veins are extremely strong, usually well-defined, the strike is regular, apparently without important faulting, and they may be followed by frequent outcrop for 4500 to 6000 feet upon the properties under consideration, beyond which they extend. Their persistence on strike and their general strength should be favorable to a similar persistence in depth.

The principal veins occupy fissures which sometimes conform in strike and dip to a minor system of joint planes of the granodiorite, but always cutting across the major joint planes at a high angle. There is evidence of movement within the veins (brecciation and slickensiding) since the fissures were filled, and of great activity on the part of thermal solutions, altering, replacing, and silicifying the original gangue material. In many instances these solutions have profoundly altered the wall rock for considerable distances, so that superficial observance may sometimes attribute to the veins a width in excess of that which is actual. At least five periods of mineralization is observable in these veins.

A common origin is established by their striking similarity, and their mineralization is generally similar. The vein material itself is often a more or less completely altered and silicified country rock, with bluish quarts, black tourmaline, epidote, calcite and other minor gangue minerals, and carries a high percentage of iron. This mineral, much oxidized at the surface, imparts a rusty brown appearance to the outcrops, wholly unlike the typical white quartz usual to California gold-bearing veins. On account of the high iron content some of the veins weather more rapidly than the enclosing country rock, their course being traceable by a depression instead of an outcrop. They differ materially from the usual California gold vein, in that they contain much less quartz and an unusually high per cent of metallic sulphides.

Glacial activity is evident throughout this region, grooving of the present rock surfaces by ice action being visible. In the limited time since the Ice Age, oxidation has made but moderate headway, and heavy, unaltered sulphides are encountered almost at the surface. Mining has been largely confined to shallow workings along the veins, in the semioxidized zone.

Lindgren states: ''On the decomposed surface much free gold occurred which, however, was soon replaced by the sulphides mentioned and in which the gold occurs in extremely fine distribution.'' This fineness will be a great advantage in treating the concentrated pyrite by cyanidation.

Pyrite is by far the most abundant sulphide and is to be found in all veins. In some veins arsenical and cupriferous sulphides occur in quantity, the latter to such an extent as to have economic importance and the former in quantity sufficient to constitute a metallurgical nuisance. Lead and zinc sulphides occur but not in quantity. The greatest gold values occur in conjunction with pyrite, chalcopyrite and arsenopyrite, and least with zinc blende and galena. Pyrrhotite, sparingly encountered, is practically barren. Silver is negligible in the pyrite ores, ranges from two to fifteen ounces with chalcopyrite, and from six to thirty ounces with galena. Where chalcopyrite is present copper ranges from 2 to 10 per cent. In the pyritic ores copper is sometimes present to the amount of one-fourth of 1 per cent, zinc and arsenic being present in smaller quantity. The pyrite usually shows free gold on panning; the other sulphides do not.

Gold is rarely found in the quartz, but appears to have been brought in by the same solutions which deposited the pyrite, arsenopyrite and chalcopyrite. Generally the quartz is barren. Pyrite is by far the most abundant sulphide, possibly constituting 95% of all sulphides in these claims.

Early Metallurgical Difficulties

The occurrence in great quantity (15 to 20%) of these several sulphides, resisting amalgamation and too low-grade usually for shipment of concentrates to far-distant smelters under the then-existent conditions (no transcontinental railroads in existence; Swansea, Wales, nearest accessible smelter by sailing vessel around the Horn), repeatedly defeated the efforts of the pioneer miners to extract the substantial values shown by assays, except by roasting and chlorination at prohibitive cost. The seven primitive quartz mills, and the several arrastres, treated the ores of the shallow oxidized zone (15 to 40 ft. deep) with a reasonable degree of success. They failed completely as the sulphides were encountered. The mine operators had but small means at their command, and when the so-called 'rebellious' ores appeared the situation to them appeared hopeless.

In Thompson & West's "HISTORY OF NEVADA COUNTY," published in 1880, the metallurgical problem was summed up in this terse statement:

> "Many unsuccessful attempts were made at milling the ores. By no known process could the ores be worked."

One after another the operators yielded to discouragement and sought other fields. Practically abandoned, Meadow Lake had a 'black eye,' in miner's parlance, because the metallurgists of that day were not able to extract gold from sulphide ores at a profit under the conditions which then existed. Of equal importance but often lost sight of is the further fact that the primary sulphide ores contained but 30% to 50% of the gold value of the oxide ores. Lindgren states:

> "The free gold found at the surface soon gave way to relatively poor sulphides and the boom speedily collapsed."

It must be borne in mind that at the date of peak activity at Meadow Lake metallurgical knowledge was limited, and processes and machinery were crude. Aside from smelting, no process now in use for difficult ores had been developed—and all smelters were too far distant, transportation methods being considered. Concentrators then in use were inefficient. Modern riffle tables had not been perfected, and the cyanide and flotation processes were in the distant and undreamed of future. It is no indictment of the mines of Meadow Lake that the methods of 65 years ago were unequal to the solution of a problem in metallurgy which has only yielded to great advancements in the art, made within the past 15 years and still being improved and modified in a nearer approach to perfection.

Hartley, almost alone, maintained his faith in the face of all discouragements. In a small way he continued to operate, hauling ore from shallow workings to his mill and constantly experimenting. On a modest scale he prospered. He sent his wife to Europe to complete her musical education and it was while she was absent that he was murdered. After his death in 1892 his widow came into control of the Excelsior mine, and shortly prior to her death she disposed of the property.

The new owners made some alterations in the mill, but did not succeed in adapting it to profitable treatment of the ore, and it soon closed down and has so remained until the present time. Their lack of success was not due solely to unsuitable equipment and an improper process, but was equally due to the small scale upon which they and all others in this camp have operated. No mill in the district has ever had a capacity greater than 30 tons per day, and on moderate grade ore (average probably around $10, with considerable loss in the tailings) profit was—and is—impossible on so small a capacity. Under Meadow Lake conditions quantity production is imperative if a profit is to be realized.

Years of litigation followed the final shut-down of the Excelsior, and after that was terminated no further efforts were made to operate any of the other properties of the camp, and the mines of Meadow Lake almost passed from the memory of the mining fraternity. The idle mill on the Great Eastern group of claims (a larger and possibly a richer mine than the Excelsior), had been destroyed by fire of incendiary origin at an earlier date, and there existed neither the facilities nor the incentive for attempting to open up that or any other property. A few small shipments of $35 to $50 hand-sorted copper-gold ore were made to smelters from one of the neighboring mines without much profit. After these shipments—complete stagnation until the increasing price of gold justified a revival of interest in such forgotten mines as these, where changed conditions now make profitable operation a reasonable certainty.

Values and Mill Records

In the five years when the district was most active (1865–1870), thousands of feet of shallow workings on many different claims were run (cuts, shafts, drifts, tunnels), and every observed showing of oxidized ore carrying substantial values was mined out, the ore being milled in the several mills and arrastres. In the 65 years which have elapsed since, nearly all these workings have caved or are full of water, making it impractical to attempt to sample them except at considerable cost. However, the value of the ores which were extracted may be ascertained with some degree of accuracy from other angles of approach.

After mining activity ceased, thousands of tons of ore remained on the dumps—ore too low-grade to haul or pack to the custom mills of early days, when $15 to $40 was the charge for milling and only the best ore was rich enough to show a margin over mill charges. Mrs. Anderson, of Auburn, owner of an adjoining mine, states that for several summers in the early part of the present century a small company of Mexicans with a pack train transported ore which they sorted from these dumps to a 4-stamp mill, where they worked it—presumably at no great profit.

Samples taken at random by myself from these dumps as they now stand assayed in gold from $2 to $40, and I have panned gold from every claim under consideration (save one) with pannings estimated as covering the range of assay values stated. However, the best key to the probable value of the ore milled in early days is to be found in the only comprehensive chronicle of the mining events of those times—the Mining & Scientific Press—with allowance being made for probable exaggeration and inaccuracy. Diligent search of those columns brought to light a number of accounts of ore milled, with tonnage given, which seem credible.

Obviously the occasional items that appeared in print constitute an incomplete record of such events. Only 21 claims out of the 1200 located are referred to with sufficient definiteness as to bear the hallmark of accuracy, and no definite data whatsoever appears with respect to those claims which worked their ore in arrastres. Incomplete as is the record, it assists in fixing the general value of the ores of the Meadow Lake mines, provided the values stated are discounted 50 per cent to compensate for the tonnage of low-grade ore sorted out and left on the dumps as worthless. I consider it necessary to adopt this heavy discount as a factor of safety to guard against possible overvaluation of run-of-mine ore.

In every case the *gold recovery per ton* of ore treated is given. Silver, copper and lead are not included in the yield, since the mills were not equipped for saving those metals. The amount of gold lost in tailings is aboslutely unknown, and usually the gold contained in the sulphides (rarely saved although sometimes greater in value than the free gold recovered) was not included in the values stated, therefore such values are *below the true worth* of the ores listed in the following table:

Name of claim	*Tons milled*	*Gold recovered per ton*
White Mountain	0.10	$36.00
Enterprise	87	98.00
Confidence *	4	53.50
Pacific *	45	37.50
California *	tonnage not given	39.88
Indian Boy *	tonnage not given	20.00
Knickerbocker *	tonnage not given	50.00
Mohawk & Montreal	393	31.44
Primrose	tonnage not given	33.00
U. S. Grant	318	53.73
Alhambra	20	13.00
Excelsior *	130	35.25
Moscow *	5	16.40
Golden Eagle *	15.5	24.00
Green Emigrant *	227	33.86
Live Oak	tonnage not given	75.00
Lake	tonnage not given	30.00
Empire	35.5	19.90
Wisconsin	2	31.00
Greenhorn	120	23.00
Gold Run	4	30.00

* Included in group under consideration usually under changed names as they have been relocated since pioneer days.

The range of values is from $13 as a minimum to $98 as a maximum, the latter from the Enterprise in the southern part of the district, a mine credited with having produced a shipment of select ore that brought $2.50 per pound. The Enterprise shipped another lot (5½ tons) to Swansea which assayed $411.50 per ton, and sold 2200 pounds on the dump for $1,322—specimen ore, of course. This occurred prior to 1870.

Specimen ore was rare but is to be reckoned with as an occasional probability, although unlikely to ever create a 'high grading' problem such as has occasioned such enormous loss at Grass Valley. In 1901 it is alleged that gold to the amount of $1,000 in a single gold pan of ore occurred in a small pocket on the Great Eastern claim. Another pocket of high grade is stated to have been taken from the Excelsior mine. All these stories must be taken with a grain of salt; but the fact that specimen rock occasionally is found at Meadow Lake was proved to my personal satisfaction in August, 1934, when some prospectors who have a claim about 1500 feet northwest of the Excelsior mine took 7½ ounces (nearly) of gold from a small pocket in a vein of sulphide ore at a depth of ten feet. Some of the rock that was shown me was easily worth $25 per pound. I panned pyritic ore taken by myself from the vein within two feet from where the specimen rock was found. Even under a good glass it did not show a color of free gold, although it assayed $16.12. However, the mines must stand or fall on the large tonnage of mill ores which may be expected from the ten or more veins within the consolidated properties specifically described in this report.

The value of such ores appears to have ranged from $6 to $10 per ton generally, at $20.67 per ounce for gold, exclusive of any other metals the ores may have contained. This value will be used for gold throughout this report unless present value is specified. In support of the values stated for the mill ores, I shall quote all whose statements have come to my notice who may have been in a position to know whereof they speak:

In 1868 J. Ross Browne, the eminent mining engineer, in an official publication, makes the following statement:

> "The quartz contains an unusually large proportion of sulphurets, averaging, it is said, 20 to 25 per cent. The sulphurets yielded by assay $60 to $75 per ton."

Such a value for the sulphides (concentrates) gives a value of at least $12 to $15 for the ore before concentration.

In 1887, in a report to his company (which had a lease and option on the Excelsior mine) A. P. Whittell of San Francisco, superintendent for Clement Mine & Mill Company, stated as follows:

> "From careful battery sampling of the vein in numerous places, I find we have immense quantities of second grade ore, mostly free-milling, assaying from $5 to $6 per ton in gold, and an abundance of first grade ore, carrying a higher percentage of sulphurets, and assaying from $8 to $14 a ton gold. I leave out of the question sundry rich streaks in the vein, varying from a few inches to a foot or more, which assay from $18 to $100 per ton."

In 1891, the year before Hartley's death, the Excelsior mine was refers to Hartley's recovery of $6 per ton in gold at an over-all cost of $2.50 per ton. No concentrates were saved and the gold was recovered in a primitive mill on canvas tables, where tailings losses were not determined. Width of vein is given as 20 ft. (See page 454, Report VIII of State Mineralogist.)

In 1891, the year before Hartley's death, the Excelsior mine was examined by Theo. H. Lowe, a Denver mining engineer. In the matter of values his report recites:

"General average of ore	$14.50
General average between walls	5.20
Best ore	82.44"

Lowe gives the veins a width of 6 to 25 ft.

In the same year Mrs. Hartley went to London, her native city, and there unsuccessfully tried to sell the five patented claims of the Excelsior mine, about 36 acres in area, for 100,000 pounds. Based on the results of her husband's operations from 1864 to 1891, inclusive, Mrs. Hartley represented the Excelsior ore to run from $7 to $14 per ton and to contain an average sulphide content of 17%. Concentrates made on canvas ran from $40 to $84 per ton.

In 1894 an article descriptive of the veins of Meadow Lake by Lindgren was published in the Mining and Scientific Press, in which occurs the following reference to ore values:

> "Considering the difficulty of access and climate, there is some doubt as to whether any of the deposits can ever be worked with profit. The ores will not average more than from $7.00 to $10.00 per ton at the most."

Lindgren little dreamed then that forty years of progress in the mining industry would develop an Alaska Juneau, making a profit from ore averaging less than $1.00 per ton, and that $7.00 ore would furnish a fair profit margin on a quantity basis even under such transportation and climatic conditions as those of Meadow Lake. Nor could he possibly have visualized the increase in such a profit margin as will now accrue from the advance in the price of gold.

In 1902 Chas. W. Raymond, mining engineer, writing in the Mining and Scientific Press of January 25, of the operations of Captain E. C. Ord, then holding options or leases on Meadow Lake properties, gives details of two mill-tests on ore from the Great Eastern claim, running respectively $45.21 and $20.67 in gold; also a similar test on Great Western ore of a value of $13.60.

He refers to 1500 tons of ore on the Fraction dump which will yield "fully $10.00 per ton," and 2,000 tons on the Great Western dump that will assay "over $10.00 per ton." The New Hope claim (formerly known as "Cash-on-the-Dump") is credited with 6 to 7 ft. of $10 to $15 ore and "1,200 tons of good ore are piled up on the dump alongside the road." My samples from this rump run from $6 to $24 but on tonnage Raymond's figures are too high. Referring to Hartley's operations at the Excelsior mine, he gives the following data relative to mill results during the latter period of activity:

5 tons, amalgamation only	$9.25 per ton
8 tons, amalgamation only	11.00 per ton
600 tons, amalgamation only	7.00 per ton
300 tons, amalgamation only	7.34 per ton
10 tons, amalgamation only	12.38 per ton
53 tons, amalgamation and concentration	23.24 per ton
410 tons, canvas tables, no plates	7.00 per ton
3 tons tested by cyanide process, 90% recovery	8.10 per ton

For the 1389 tons treated, an average of $7.77 is shown as the actual gold extraction—the concentrates being saved from but one small lot—and no data whatsoever given as to tailings losses, which must have been fairly high at all times and particularly so when milling without plates.

I have in my possession data covering the last run of the Excelsior mill in September, 1905, at which time the mine was operated by a group of miners under a lease. The recovery was $10.14 per ton from 266 tons, with no statement as to amount lost in tailings or the value of concentrates, although concentrates were being made at the time.

In 1907 the Excelsior mine was again examined, this time by Henry J. Gray, E.M., of Denver. In his report there occurs the following statement: "Assays taken along the two veins for a distance of 2,000 feet show an average gross value of the crude ore to be $10.00 per ton." Gray also states:

> "At the bottom of the south winze-shaft, which has a depth of 105 feet, two drifts have been run upon the vein a total length of 130 feet. * * * For the full

length of this drift the ore has an average width of 12 feet, and in no place has either wall been cut."

James L. Voorhies, of Sacramento, has informed me that in 1910 he unwatered the 90 ft. shaft on the Fraction claim and from the bottom drifted 18 ft. toward the Great Western claim, where he had 8 ft. of sulphide ore in the face which assayed $12. He stated that a deal was on for the purchase of this claim in connection with the claims of the Great Western group, both deals collapsing when the owner of the latter raised his price from $85,000 to $125,000. Mr. Voorhies bears an excellent reputation and I accept his statement at face value.

In 1915, before caving had occurred and before water had filled the level referred to by Gray, and after the shaft had been sunk to its final depth of 115 feet, the mine was examined by Charles L. Whittle, a Boston mining engineer. His report is generally pessimistic, and stresses the well-known disadvantages of isolation, winter conditions and transportation difficulties. He dwells upon the fact that during 50 years since original discovery no mine of importance had been brought into sustained production, but omits all mention of the metallurgical problem which baffled the pioneers—nor does he comment on the small-scale operations and unsuitable mill equipment of the later operators, which made profit to them an impossibility in an expensive district on medium-grade ore. He ignores entirely the occasional occurrence of shoots of ore of better-than-average-grade—a condition entitled to recognition in every mining district in California—and appears unable to recognize the potentialities of the situation.

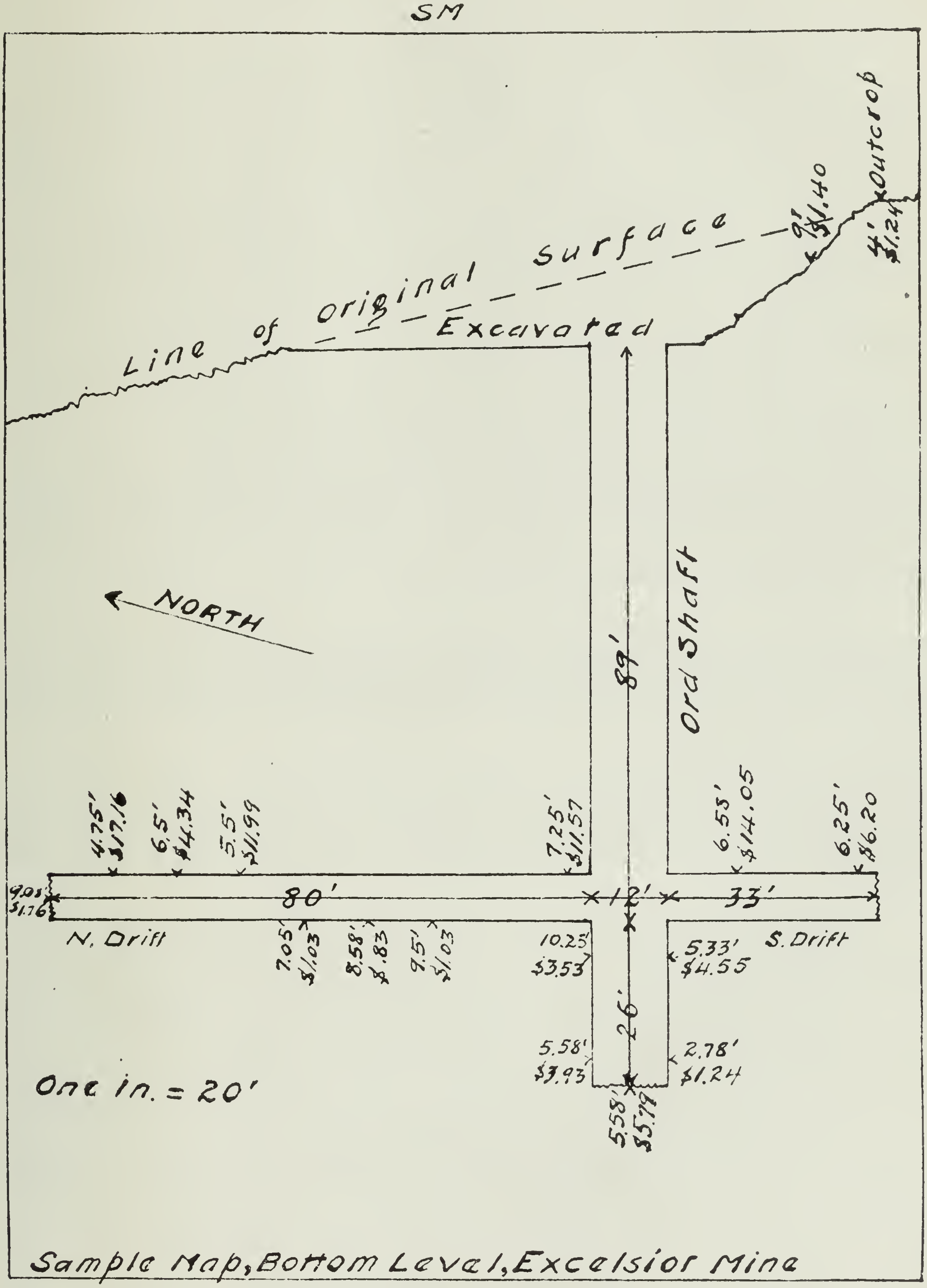
The impression created is of one none too sure of himself or none too familiar with gold mining. This impression grows as one reads his reference to veins "sometimes *only* 5 or 6 feet wide" as being "*very narrow*," or when he writes, "The veins are *narrow*, averaging about 6 feet in width, but are strong and persistent." (The italics are mine.)

When it is recalled that the veins of the greatest mining district in California—Grass Valley—average *but two feet* in width, the suspicion becomes a conviction that Mr. Whittle was possibly more familiar with the huge deposits of copper mines, once favored by Boston investors, than with gold mining in California. In one respect his report is particularly valuable; he lists the width and assay value of samples cut across the vein on the now-inaccessible bottom level of the Excelsior, and from the 26-ft. section of the shaft below that level, this section being 12 to 14 ft. deeper than when sampled by Gray in 1907. From his listing I have constructed the vertical section and assay map shown herewith.

The values are spotted but the vein is always of large size. Unfortunately, Whittle fails to state whether the width sampled was the full width of the vein, and no check is had on Gray's statement that, "For the full length of this drift the ore has an average width of 12 feet, and in no place has either wall been cut."

In computing values I have used the foot-dollar method. The 12-ft. section of the level which was cut out by the width of the shaft I have restored by giving it the average width and value of the five samples taken in the 26-ft. section below the level. Thus the samples are brought to the same horizontal zone. The result is 7.04 ft. of

$5.88 ore, if the level be considered as 100% mill ore. However, in the north drift the face sample and three 10-ft. sections (a total section of 35 ft.) have a value below minimum mill grade. In stoping (with proper stope sampling), such low-grade vein material would be left unbroken as pillars or used as stope filling—it would not go to mill to dilute the value of pay ore.


SM
Line of original Surface
Excavated
9'
$1.40
4'
$1.24
Outcrop
NORTH
89'
Ord Shaft
4.75'
$17.16
6.5'
$4.34
5.5'
$11.99
7.25'
$11.57
6.55'
$14.05
6.25'
$6.20
9.05'
$1.76
80'
12'
33'
N. Drift
7.05'
$1.03
8.58'
$.83
9.5'
$1.03
10.25'
$3.53
5.33'
$4.55
S. Drift
26'
5.58'
$3.93
2.78'
$1.24
5.58'
$5.79
One in. = 20'

Sample Map, Bottom Level, Excelsior Mine

Excluding this low-grade material (averaging 8⅔ ft. wide by 35 ft. in length), the portion of this level that would be stoped and sent to mill (6.1 ft. wide by 90 ft. long) *averages $9.70 per ton,* a satisfactory grade of mill ore. This area of mill ore represents *64.4% of the entire tonnage* of the vein on the level covered by Whittle's sampling. His two samples taken in the cut and on the outcrop south of shaft are much lower in value than that taken in the face of the south drift, 100 ft. immediately underneath.

The factors of average size, average value, and percentage of mill ore are entirely satisfactory under today's conditions, yet Whittle's conclusions may have been entirely sound when he rendered an adverse report 21 years ago. At that time he viewed Meadow Lake from the angle of the Excelsior property standing alone—less than 36 acres in area and controlling but 2,000 ft. along the apex of one vein system. No consolidation such as is now proposed was then under consideration—a consolidation controlling more than 15,000 ft. along the apex of not less than 10 veins and an area of around 300 acres.

In 1924 C. A. Logan, district engineer of the Sacramento Field Division of the State Mining Bureau, made a reconnaissance of the Meadow Lake region and his findings were published in the annual report of the Bureau for that year. Bearing on the subject of values the following extract is taken from Logan's summary:

> "The ores worked yielded from $3 to $37 per ton generally, but some went higher, and it is likely that $6 to $10 a ton would be a fair figure for the value of the ore now in sight, although a great many higher assays are quoted. Quite a few pockets have been found in the district, notably one from the 60-foot level of the Excelsior mine in 1889. The total bullion yield has been possibly $200,000; up to 1877 it was estimated to have been $125,000. Some selected lots of sorted ore have been shipped to smelters."

At my instance in October, 1933, Thos. V. Reeves, San Francisco mining engineer and geologist, made an examination of the properties under consideration. Concerning the vital matters of value of the ore, width of vein, and percentage of ore in the vein his report contains the following statement:

> "I believe that a mill grade of ore can be maintained with value between eight and ten dollars per ton with gold at $20.67 per ounce. The surface indications are that about one-third of the vein area developed will be productive, and that vein widths from five to twelve feet will maintain. There are several outcrops with widths of over fifty feet, and I think it safe to assume an average width of eight feet."

By reason of the fact that all the principal early-day workings are either more or less caved or full of water, it has been impossible for me to systematically sample the several properties, but in seven places on three of the claims (Fraction, Great Eastern, Great Western) I was able to cut across vein widths of from 2 to 9 ft. Computed by the foot-dollar method the weighted average of these samples was $8.00 gold, 60¢ silver, $3.96 copper; silver being valued at 77¢ and copper at 9¢.

In addition I took 52 hand samples, representative of every type of ore to be found on widely scattered dumps on 15 claims, omitting only three of minor importance (Wotell, Blue Fox and Of What No. 1). Gold ranged from 83¢ to $82.81, the average value being $8.40. To this average silver adds 80¢ and copper 72¢. The maximum silver value was 31 ounces. This unusual value occurred in connection with 81% lead in a select specimen of galena ore from Dam End claim—a type of ore not often encountered at Meadow Lake. The best copper ore (assaying 16%) was in the form of chalcopyrite, accompanying the gold assay of $82.81. The sample ran 15 oz. silver. It was taken in the southeast corner at the bottom of the 25-ft. shaft on the Great Eastern claim, where ore of this character is making its appearance.

In the mass of value data presented there is close agreement, and general corroboration of the opinion expressed by C. A. Logan, of the State Mining Bureau, that average values would range from $6 to $10. Such values accord closely with the assays from my own random sampling, and with the opinion I formed as a result of making hundreds of pannings along thousands of feet of outcrop on the several veins. In consequence, I reach the final conclusion that mill ore in large quantity of an average value in excess of $8 per ton in gold is a reasonable expectancy, gold having been valued throughout this report at $20.67 per ounce to avoid confusion in referring to earlier reports.

In support of this conclusion I have recently obtained written statements from the only two men now living who have personal knowledge of the last operations at Meadow Lake, which occurred at the Excelsior Mine from 1901 to 1905.

From the statement of Mr. James N. Hawks, of Sierra Madre, California, assayer from 1901 to 1904, I take the following:

> "My memory is not absolutely clear as to the value of the average ore, but to the best of my recollection the mill heads generally ran about $6, although very much higher at times. But I do remember clearly that the ore from the underhand stope that was taken out to make a payday for us just before the mine closed down went $18 to $20. The full width of the vein was milled without sorting, in order to provide sufficient tonnage. The vein was uniformly of large size—often as wide as 12 feet."

Mr. Robert T. Jones, of Grass Valley, was mine foreman from 1902 to 1905. He states:

> "The vein was very large—as wide as 26 feet in one place—but 12 feet was the greatest width stoped. The ore was milled without sorting and the average gold value was about $8.00. The last mill run, in the fall of 1905 just before the mine closed down, was on ore underhand stoped from the bottom level. This ore was better than the average, and plated $10 per ton."

More than 10,000 tons of Excelsior ore was milled in the period covered by these two statements. As the ore was milled without sorting for the full width mined, an average gold value of $6 to $8 appears to be conclusively established. At present gold price a value of $10.15 to $13.55 per ton is shown by these mill runs, and on a scale so large that this test is more convincing than any mine sampling which could possibly be made by engineers. It is my definite conclusion that an average value of at least $10 per ton at present gold price is reasonably to be expected from the Meadow Lake orebodies.

There is insufficient data upon which to express an opinion as to the percentage of material within the walls of the several veins which will show such an average value, and the ratio of 64.4% shown by Whittle's sampling on the lower level of the Excelsior is undoubtedly better than will be found in some other sections. I am of the opinion that extensive sections along the veins in the Great Eastern group and the New Hope claim will show values equal to the section in the Excelsior, although the smaller amount of development on these other properties provides less evidence to support this belief. However, I am strongly of the opinion that around 50% of the ore of the principal claims will be payable on the basis of all conditions as they exist today, provided development and equipment be upon a scale large enough to fully realize the economies of quantity production—such as would govern an intelligently managed factory operation, with an unlimited market and a solvent customer who would take the entire plant output—as is the case with gold.

* * * * * * *

Lindgren and all others who are known to have examined these mines are in practically unanimous agreement that the ore has an average value of $6 to $10 at the value of $20.67 per ounce—equivalent to $10.15 to $16.93 with gold at $35.00.

Present metallurgical processes will make a satisfactory saving of these gold values, to which a slight addition may be made for the silver and copper in some of the ores. An extraction of 87½% to 95% is a reasonable expectancy for the gold values. Only the pyrite concentrates can be successfully treated by cyaniding. Concentrates carrying substantial values in copper or lead must go to smelters, but such concentrates will contain by-product values to offset additional charges.

ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist.

Personnel

There have been no changes of personnel in the Division of Mines to be noted the past three months.

New Publications

'CALIFORNIA JOURNAL OF MINES AND GEOLOGY,' October, 1935, being Chapter 4 of State Mineralogist's Report XXXI. This chapter contains: 'Mines and Mineral Resources of San Luis Obispo County'; 'Mineral Resources of Portions of Monterey and Kings Counties'; 'Mining Activity at Soledad Mountain and Middle Buttes—Mojave District, Kern County'; 'Geology of a Portion of the Perris Block, Riverside County' (with map); 'Mineral Resources of a Portion of the Perris Block, Riverside County'; 'Sources of Gold Produced in California from 1848 to 1934' (with chart and table).

Commercial Mineral Notes (Nos. 154–156, inc.), February-April, respectively. These 'Notes' contain the lists of 'mineral deposits wanted,' and 'mineral deposits for sale,' issued in the form of a mimeographed sheet monthly. It is mailed free to those on the mailing list for 'CALIFORNIA JOURNAL OF MINES AND GEOLOGY.' As an evidence of the interest in mines and mineral resources now showing considerable activity, this mimeographed 'sheet' has had to be expanded to three pages in recent months.

Mail and Files

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.

MINERALS AND STATISTICS

Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

STATISTICS

The counties of California have produced for some years past more than 50 different mineral substances, the total value of which was estimated at $256,938,000 for 1935. See January, 1936, issue of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

At present (April, 1936) reports for most of the producers are in hand. Data for several substances are now complete and have been compiled, being presented herein. Information at hand indicates that there was no commercial production during 1935 of the following: antimony, arsenic, asbestos, bismuth, fluorspar, lepidolite, molybdenum ore, serpentine, shale oil, strontium, tin, titanium, and wollastonite.

There was a single producer, each, of the following: bromine, calcium chloride, carbon dioxide, graphite, iodine, magnesite, manganese ore, mica, mineral paint, potash, pyrite, and sulphur.

BARYTES

During 1935 there was a commercial production of barite in California amounting to a total of 22,979 short tons valued at $133,810 f.o.b. railroad shipping point, as compared with the 1934 output of 21,769 tons worth $125,514.

The 1935 output came from Mariposa, Plumas, and Tulare counties with a single producer in each. This material was consumed in the manufacture of lithopone, in heavy-gravity oil-well drilling-mud, fillers, and barium chemicals.

The Tariff Act of 1930 placed a duty on foreign imported barytes ore, crude or unmanufactured, of $4 per ton; ground or otherwise manufactured, of $7.50 per ton.

Present quotations for barite (93% $BaSO_4$) vary from $6 to $7 (Calif. $7) per ton, crude, f.o.b. rail-shipping point. Most barite has to be washed and acid treated to remove iron stains or other impurities before being suitable for paint use.

Known occurrences of this mineral in California are located in Inyo, Los Angeles, Mariposa, Monterey, Nevada, San Bernardino, Shasta, Santa Barbara and Tulare counties. The deposits at El Portal, in Mariposa County, have given the largest commercial production to date, in part witherite (barium carbonate, $BaCO_3$). Witherite has also been found in Shasta County, but no shipments have yet been made from the deposit.

BORATES

During the year 1935 there was produced in California a total of 263,915 short tons of borate materials, compared with 240,732 short tons for 1934. The material shipped during the year included the new sodium borates, kernite (rasorite), kramerite from Kern County; also crystalized borax prepared by evaporation of brines at Searles Lake in San Bernardino County and Owens Lake in Inyo County.

As the crude ore is not sold as such, but is almost entirely calcined before shipping to the refinery for conversion into the borax of commerce, and because of the fact that the material varied widely in boric acid content, we have recalculated the tonnage to a basis of 40 per cent. A. B. A. This is approximately the average A. B. A. content of the colemanite material after calcining, and also of the crystalized borax obtained from evaporation of the lake brines.

Recalculated as above, the 1935 production totaled 280,249 short tons valued at $4,602,046. This was an increase in quantity with a decreased value as compared with the 1934 output of 240,696 tons worth $5,524,262.

The total amount of borates exported from the United States during 1935, according to the U. S. Bureau of Foreign and Domestic Commerce, was 114,447 short tons valued at $3,242,350, as compared with 103,643 tons worth $2,997,276 in 1934.

CEMENT

During 1935 there was a production in California of 8,086,292 barrels of cement valued at $10,120,721 f.o.b. plant, of which 2,948,575 barrels came from northern California plants and 5,137,717 barrels from southern California plants. The 1935 output was a decrease from that of 1934, which was 8,936,085 barrels worth $12,445,616.

Shipments during 1934 were made from ten plants in nine counties to the extent of 8,167,595 barrels valued at $11,065,516, as compared with 8,591.951 barrels worth $12,417,337. There were operating during the year, five plants in northern California, one each in Calaveras, Contra Costa, Merced, San Mateo and Santa Cruz counties, which shipped 3,030,105 of cement, and five plants in southern California, two in San Bernardino and one each in Kern, Los Angeles,[1] and Riverside counties, which shipped 5,137,490 barrels. There were 1656 men employed in the above plants in 1935.

CHROMITE

During the year 1935 there were shipments of chromite or chromic iron ore in California amounting to 488 short tons, recalculated to a basis of 45% Cr_2O_3, valued at $6,111 f.o.b. shipping point, and came from Fresno, Napa, Placer, San Luis Obispo, and Shasta counties. This was all material that had been mined for several years but not sold until 1935. The 1935 shipments showed an increase in both amount and value over those of 1934 which were 294 tons worth $3,498.

Occurrence

Chromite is widely distributed in California, the principal production, thus far, having come from El Dorado, San Luis Obispo, Del Norte, Shasta, Siskiyou, Placer, Fresno, and Tuolumne counties. In 1918 a total of 29 counties contributed to the State's output. There are two main belts in California yielding this mineral, one along the Coast Ranges from San Luis Obispo County to the Oregon line, including the Klamath Mountains at the north end, and the other in the Sierra Nevada from Tulare County to Plumas County. Chromite occurs as lenses in basic igneous rocks such as peridotite and pyroxenite, and in serpentines which have been derived by alteration of such basic rocks.

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[1] The plant in Los Angeles County grinds clinker coming from Kern and San Bernardino counties, therefore the crude material is credited to the latter two.

Imports

Imports during 1935 to the United States, of foreign chromite[1] duty free, mainly from Rhodesia, New Caledonia and India, totaled 253,946 long tons valued at $3,538,380 for the year 1935, compared with 190,797 tons worth $2,250,787.

GYPSUM

During the year 1935 there were shipments of gypsum in California amounting to 70,833 short tons valued at $151,807, coming from three properties in Fresno County and a single property each in Imperial and Riverside counties. This was an increase in both quantity and value over the 1934 output, which was 58,149 tons worth $113,606.

LIME

In California during 1935 there was an output of lime amounting to 59,731 short tons valued at $573,212 coming from two plants each in El Dorado, San Bernardino, and Santa Cruz counties; and one each in Alameda and Tuolumne counties. The above figures showed an increase in both amount and value over those of 1934 which were 32,500 tons worth $309,765.

So far as we have been able to segregate the data, these figures include mainly only such lime as is used in building operations; though they do include a small proportion of calcined lime employed in agriculture and the chemical industries, the figures for which were not separable. A portion is hydrated lime. Limestone utilized in sugar making, for smelter flux, as a fertilizer, and other special industrial uses, are classified under 'Industrial Materials.' That consumed in cement manufacture is included in the value of cement.

LIMESTONE

'Industrial' limestone was produced on 17 properties in ten counties in California during 1935 to the amount of 227,214 short tons valued at $496.054, being an increase in both amount and value over that of 1934 which was 198,057 tons worth $481,139. The 1935 yield came from four operators in El Dorado County; three in Santa Clara County; two each in San Bernardino, Santa Cruz, and Tuolumne counties; and one each in Alameda, Fresno, San Luis Obispo, and San Mateo counties.

The amount here given does not include the limestone used in the manufacture of cement nor for macadam and concrete, nor of lime for building purposes; but accounts for that utilized as a smelter and foundry flux, for glass and sugar making, and other special chemical and manufacturing processes. It also includes that utilized for fertilizers (agricultural 'lime'), 'roofing gravel,' paint and concrete filler, whiting for paint, putty, kalsomine, terrazzo, paving dust, chicken grit, carbon dioxide gas, 'paving compound,' facing dust for concrete pipe, also for rubber and magnesite mix. The material from Fresno and Ventura counties and one operator in Santa Clara County was marl; and that from Alameda, San Mateo and three operators in Santa Clara counties was shells, dredged from San Francisco Bay, all of which was ground and used for agricultural purposes and poultry grit. Of the total 'industrial' limestone produced in 1935 approximately 35,933 tons valued at $128,233, were used for agricultural purposes and poultry grit.

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[1] Monthly Summary of Foreign Commerce of U. S. Bureau of Foreign and Domestic Commerce, December, 1935.

Distribution of the 1935 output of limestone was as follows:

County	*Tons*	*Value*
El Dorado	151,814	$298,867
Santa Clara[b]	30,613	71,381
Alameda[b], Fresno[a], San Bernardino, San Luis Obispo, San Mateo[b], Santa Cruz, Tuolumne *	44,787	125,806
Totals	227,214	$496,054

* Combined to conceal the output of individual operators in each. [a] Includes marl; [b] includes shells.

MAGNESIUM SALTS

During 1935 there was an output of magnesium salts in California coming from one plant in San Diego County and two in San Mateo County, amounting to 2785 short tons valued at $235,531 and consisting of the carbonate and chloride. The 1935 production was an increase in both quantity and value over that of 1934, which was 2325 tons worth $194,642. The chloride was nearly all sold for use in magnesite stucco and cement mixtures (Sorel cement) also some for road liquor. The carbonate, a bulky white powder, was used as a heat-insulating material, as a filler for rubber, paper, paint, etc., and in medicines, in toothpaste, in face powder and as a polish for metal and glass. The sulphate marketed was utilized for medicinal and bath purposes. The material coming from San Diego County was residual bitterns from the salt plants and was in part marketed in the liquid form carrying from 35% to 67% $MgCl_2$ and in part as dry crystals, while that from San Mateo County was magnesium carbonate.

The average value reported for the chloride produced in California in 1934 was approximately $46.80 per ton, f.o.b. plant.

QUICKSILVER

The production of quicksilver in California during the year 1935 amounted to 9353 flasks valued at $628,590. This was an increase in both amount and value over the 1934 figures which were 7946 flasks worth $534,135. The distribution of the 1935 output by counties was as follows:

County	*Flasks*	*Value*
Lake	4,097	$285,426
Napa	1,109	60,649
San Benito	791	55,015
San Luis Obispo	2,474	167,613
Santa Barbara	110	7,854
Sonoma	81	5,474
Colusa, Fresno, Inyo, Kings, Monterey, Trinity*	308	20,058
Totals	9,353	$628,590

* Combined to conceal the output of individual operators in each.

Prices

During 1935 the average for New York monthly quotations[1] was $71.992 per 76-lb. flask. The average price for 1934 was $73.867. The average price for January was $62.76, dropping to $69 in August and raising to the end of the year with an average for December of $75.20. The average price received by producers in California during 1935 was $67.23 per 76-lb. flask, compared with 67.22 per flask in 1934.

SALT

Most of the salt production in California is obtained by evaporation of water of the Pacific Ocean, plants being located on the shores of San Francisco, Monterey, and San Diego bays, and at Long Beach. Additional amounts are derived from lakes and lake beds in the desert regions (in part, rock salt), mainly in Imperial, Kern, and San Bernardino counties, and evaporation of alkaline lake water in Modoc County. A small amount of valuable medicinal salts has been obtained by evaporation of the water of Lake Mono, Mono County.

During the year 1935, in California there was an output of 365,711 short tons of crude salt valued at $1,230,480, compared with 332,194 short tons worth $1,222,810 in 1934. There were eleven plants operating in 1935 with two each in Alameda and San Bernardino counties, and one each in Imperial, Kern, Los Angeles, Modoc, Monterey, San Diego, and San Mateo counties.

The average value reported for salt produced in California during 1935 was $3.36 per ton f.o.b. plant, as compared with $3.68 in 1934, $3.89 in 1933, $3.58 in 1932, and $3.73 in 1931.

SILICA (Sand and Quartz)

We combine these materials because of the overlapping roles of vein quartz which is mined for use in glass making and as an abrasive, and that of silica sand which, although mainly utilized in glass manufacture, also serves as an abrasive. Both varieties are also utilized to some extent in fire-brick manufacture.

We do not include under this heading such forms of silica as: quartzite, sandstone, flint, tripoli, diatomaceous earth, nor the gem forms of 'rock crystal,' amethyst, and opal. Each of these has various industrial uses, which are treated under their own designations.

The production of silica in California during the year 1935 amounted to 70,835 short tons valued at $297,272 f.o.b. rail shipping point and came from two properties each in Contra Costa and San Diego counties and one each in El Dorado, Orange, Placer, and Riverside. The above was an increase in both amount and value as compared with the 1934 output of 70,432 tons worth $296,643. The 1935 output consisted of 69,756 tons of glass sand and 1079 tons of vein or boulder quartz.

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[1] Engineering and Mining Journal, Vol. 136, 1935.

In addition to the above output for 1934 there were several thousand tons of quartzite shipped from San Bernardino County to be used in the manufacture of silica brick. To avoid duplication, its amount and value is not added to the silica totals.

The glass sand came from Contra Costa, Monterey and Riverside counties. For making the higher grades of glass, deposits in Contra Costa County are replacing the sand imported from Belgium. Belgium sand has displaced local material in the manufacture of sodium silicate ('water glass'). There are various deposits of quartz in California which could be utilized for glass making, but to date they have not been so used owing to the cost of grinding and the difficulty of preventing contamination by iron while grinding.

Silica sand has been produced in the following counties of the State: Alameda, Amador, Contra Costa, El Dorado, Imperial, Inyo, Los Angeles, Mariposa, Mono, Monterey, Orange, Placer, Riverside, San Diego, San Joaquin and Tulare, the chief centers being Contra Costa, Amador, Monterey and Los Angeles counties. The industry is of limited importance, so far, because of the fact that much of the available material is not of a grade which will produce first-class colorless glass; for such, it must be essentially iron-free. Even a fractional per cent of iron imparts a green color to the glass.

The Tariff Act of June 21, 1930, placed a duty on sand, containing 95 per cent or more of *Silica* and not more than six-tenths of 1 per cent of oxide of iron and suitable for use in the manufacture of glass, of $2 per ton.

SLATE

Slate was first produced in California in 1889. Up to and including 1910 such production was continuous, but since then it has been irregular. Large deposits of excellent quality are known in the state, especially in El Dorado, Calaveras and Mariposa counties, but the demand has been light owing principally to competition of cheaper roofing materials.

The production of slate in California during the year 1935 was 8066 tons and 40 squares having a total value of $40,912 f.o.b. quarry and came from properties in El Dorado, Inyo, and Tuolumne counties. The 1935 figures showed an increase in both amount and value over those of 1934 which were 5065 tons worth $24,245. Practically all of the slate was crushed and used for roofing granules. The slate shingles came from an old quarry in El Dorado County.

SODA

The production of sodium salts in California in 1935 included: Soda ash, trona, caustic soda and bicarbonate from plants at Owens Lake, Inyo County, and soda ash, salt cake and trona ('sesqui-carbonate,' a double salt of Na_2CO_3 and $NaHCO_3$) from Searles Lake, and salt cake from near Twenty Nine Palms, both in San Bernardino County. There were no shipments of salt cake (sulphate) from the Carrizo Plains, San Luis Obispo County. The output of the year 1935 amounted to 125,504 short tons valued at $1,341,045, as compared with 99,380 short tons worth $1,219,561 in 1934.

The dense ash and bicarbonate were used mainly in the manufacture of soap, glass, paper, oil refining, sugar refining, and chemicals; and the trona for metallurgical purposes.

TUNGSTEN

The commercial production of tungsten ores and concentrates in California began in 1905; and has been continuous since, with the exception of 1920–1922 (inclusive). The material shipped in 1935 was high-grade sorted ore and concentrates, coming from a single property in Kern County and two in San Bernardino County. A total of 125 short tons were reported shipped, yielding 118 tons recalculated to 60% WO_3 valued at $194,542. The 1935 output showed a decrease in both quantity and value as compared with that of 1934, which was 261 tons worth $224,417.

Quotations in ''Metal and Minerals Markets'' during 1935 ranged from $16 to $17.25 per unit WO_3 for Chinese wolframite, duty paid; and $14.50 to $17 for domestic scheelite. The highest prices were received at the end of the year. Present (May 22, 1936) prices per unit WO_3 at New York are: Chinese wolframite, duty paid, $16; Bolivian scheelite, $16; domestic scheelite, $16.

Imports of foreign tungsten ores and alloys into the United States during 1935, according to the U. S. Bureau of Foreign and Domestic Commerce totaled 1,587,313 pounds valued at $383,656, compared with 1,570,211 pounds worth $339,634 in 1934. The Tariff Act of 1930 raised the duty on tungsten ore or concentrates to 50 cents per pound on the metallic tungsten contained therein. Duties are also provided for imported tungsten-bearing alloys.

Tungsten ore has been produced in California principally in the Atolia-Randsburg district in San Bernardino and Kern counties, followed by the Bishop district in Inyo County, with small amounts coming from Nevada County and from the district near Goffs, in eastern San Bernardino. Most of California's tungsten ore is scheelite (calcium tungstate), though wolframite (iron-manganese tungstate) and hübernite (manganese tungstate) also occur. The deposits at Atolia are the largest and most productive scheelite deposits known.

MUSEUM

The Museum of the State Division of Mines possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Division of Mines as well as by those who utilize the facilities of the collection.

Among the specimens received recently and catalogued for the Museum are the following:

20663 CINNABAR (H_gS) in SULPHUR (S)
From: West of Coaldale in Fish Lake Valley, Nevada.
Donor: E. J. Bumsted. March 1936.

20664 ALUNITE, a sulphate of aluminum and potassium—($K_2O.3Al_2O_{34}SO_3:6H_2O$).
From: Near Glen Ellen, Sonoma County, California.
Donor: A. W. Frazier. March 1936.

20665 GOLD ORE (Rand Banket) 2 pieces of ore showing free gold.
From: Springs Mines, Far East Rand, 30 miles east of Johannesburg, South Africa.
Donor: Prof. S. N. Hoffenberg. March 1936.

20666 CHALCOPYRITE ($CuFeS_2$) Sulphide of iron and copper with well-formed crystals on Dolomite.
From: Joplin, Missouri.
Exchange. March 28, 1936.

20667 RUTILE (TiO_2) Titanium oxide in ACTINOLITE.
From: Coyote Dam, six miles from Morgan Hill, Santa Clara County, California.
Donor: Paul Walker. March 31, 1936.

20668 MARCASITE (FeS_2) Iron Sulphide.
From: California Placer Mine, Sailor Flat, Placer County, California.
Donor: Leo P. Harris. March 31, 1936.

20669 Collection of Minerals and products of the American Potash & Chemical Company.
From: Searles Lake, San Bernardino County, California. April 1936.

20670 IDDINGSITE, a silicate of iron, magnesium, calcium, and sodium, with OLIVINE.
From: Amboy, San Bernardino County, California. April 1936.

20671 GOLD ORE.
From: Lucas Mine, near Mokelumne Hill, Calaveras County, California. April 1936.

20672 GOLD ORE.
From: Lucky Joe Mine, near Mokelumne Hill, Calaveras County, California. May 1936.

20673 DIATOMACEOUS EARTH (Diatomite).
From: Property of Johns-Manville Corp'n, Lompoc, Santa Barbara County, California. May 1936.

20674 Diatomaceous Earth products manufactured by Johns-Manville Corp'n, Lompoc, Santa Barbara County, California. May 1936.

20675 Fossil Fish, known as Xyne Grex in Diatomaceous Earth.
Found at quarry of Johns-Manville Corp'n, Lompoc, California.
May 1936.

NEW SPECIAL EXHIBIT OF CALIFORNIA SEMI-PRECIOUS GEM STONES

The idea of the new semi-precious gem collection in the mineral exhibit of Division of Mines, Ferry Building, San Francisco, had its inception in September, 1935, when returning some stones borrowed for exhibition at the State Fair, to William B. Pitts of Sunnyvale. We were talking about the possibilities of cut stones and their arrangement. Mr. Pitts stated that there were over fifty different varieties of gems to be found in California. He suggested that we make an educational display of these for our museum and offered his cooperation and assistance if such an arrangement should be attempted.

The method of display was decided on after some experimenting to find which was the most effective. It was to use 4½ x 6 inch dead-black cards, on which several cut stones and one piece of rough material were cemented, the description being placed on the card with white lettering. Having the stones cemented to the card keeps each individual variety intact with its description, avoiding loss and makes the collection more portable, as well as making it safe for any one to handle without fear of misplacing or mixing the stones.

One of our next tasks in connection with assembling this display was finding suitable material for cutting and polishing. Most of the rough stone came from friends of the mineral industry although in a few instances usable material was found among the samples sent in to the laboratory for determination. During the month of January, 1936, the safes with our gold exhibit were moved from the museum to the library and in the space that had been occupied by one of these was set a case for this gem collection. As soon as the first of these stones were put on public display, the amount of donations of rough material rapidly increased.

Another problem after receiving rough material, was its cutting and polishing. This was solved in the middle of December, 1935, when the W.P.A. assigned Wilfred C. Eyles as laboratory assistant. He being an amateur lapidary, was glad of the opportunity of getting practice in cutting of various kinds of stones. Francis J. Sperisen, lapidary at 166 Geary Street, San Francisco, was also very kind in cutting many stones, and giving Mr. Eyles professional advice as well as donating several specimens to this collection.

The assembling of this display has been full of intrigue to every one connected with it. Many of the stones were far better than we expected, working into most pleasing and unusual specimens, although some promising rough material proved to be porous or with fractures which did not show themselves till they were cut. All these have very vivid colors and take high polish. They prove particularly attractive to the eye and draw much attention of visitors to the museum. They should, if properly set to give correct effect, enhance feminine apparel.

With little or no effort we were able to get seven varieties of semi-precious stones in both cut and rough to start this collection; by the middle of January, 1936, we had eleven and at present 39 varieties with many more promised.

The following is a brief description of the stones collected to date:

Agate, Carnelian—from the Panamint Range, Inyo County. The material exhibited varies from a light brownish-red to a deep brownish-red. It polishes nicely and is relatively free from fractures. Donor: W. C. Eyles.

Azurite and *Malachite* in Chalcedony—from New York Mountains, San Bernardino County. Polished specimens have a deep blue with small clouds of green in an almost clear chalcedony. Donor: W. C. Eyles.

Bloodstone—from Bogus Mountain, 18 miles northeast of Yreka, Siskiyou County. The polished stones tend towards a gray-green body streaked with red, rather than green of plasma.

Bloodstone—from Panamint Range, west of Death Valley, Inyo County. This specimen is a very good quality of bloodstone. Donor: W. C. Eyles.

Californite (California Jade), a variety of vesuvianite—from Indian Creek, above Happy Camp, Siskiyou County. The polished stones are a moss green and translucent with a waxy luster resembling jade.

Californite—from the west side of the Feather River near Pulga, Butte County. This is the lemon-yellow variety which cuts and polishes well but often contains many fractures.

Californite (white)—from near Pulga, Butte County. This material compares very favorably to white jade; the rough contains some fractures. Donor: F. J. Sperisen.

(Note: All the above varieties of Californite have been shipped to China to be carved for jade.)

Carnelian—from beach at Sausalito, Marin County. These are small tomato-red chalcedony pebbles and would make most desirable gems if only found in larger pebbles. Donor: F. J. Sperisen.

Chalcedony, polished beach pebbles—from Pescadero Beach, San Mateo County. Here a great variety of different colored chalcedony is found which cuts and polishes nicely. Donor: H. E. Harper.

Chalcedony, Blue—from Leadpipe Springs, San Bernardino County. This specimen is a clear skyblue chalcedony which cuts and polishes well. Donor: Mrs. Geo. Lightburn.

Chiastolite (a variety of andalusite)—from near Daulton Station, Madera County. When cutting these crystals across the long axes, various cross and square designs are to be found—no two alike. This material will not take a high polish. Donor: W. C. Eyles.

Chloropal—from Alpine County. This sample is a yellowish green mineral that cuts and polishes well.

Chrysoprase—from 9½ miles southeast of Porterville, Tulare County. A beautiful apple-green chalcedony which cuts and polishes most effectively. Donor: W. C. Eyles.

Dumortierite—from near Ogilby, Imperial County. This sample is an indigo-blue color and polishes well.

Gold Quartz—from the Central Mine of the Lava Cap Gold Mining Corp., Nevada City, Nevada County. In these stones there is quite a lot of pyrite which is not most desirable in mineral used for cutting. Donor: John F. Bongard.

Iceland Spar—from near Cedarville, Modoc County. This material shows double refraction and is suitable for optical purposes. Donor: J. D. Patterson.

Jasper—from the excavation of the north pier of the Golden Gate Bridge, Marin County. This material is a mottled mixture of reds, blues, greens, yellows, and browns in small dabs, with some streaks of milky white. The rough material is badly fractured and it was hard to get material suitable for cutting, but cut stones are very effective. Donor: F. J. Sperisen.

Jasper, Bouquet—from near Almaden, Santa Clara County. This jasper is a mottled mixture of reds, browns, greens, and yellows. It cuts and polishes to give a very attractive stone. Donor: H. E. Harper.

Jasper, Brecciated—from Stone Canyon, Monterey County. This material is mostly yellow and brown jaspers that were badly broken up and then recemented with a milky chalcedony to form a compact mass free from fractures which cuts and polishes well. Donor: W. C. Eyles.

Jasper, Paradise—from 15 miles northwest of Hollister, in Santa Clara County. This jasper is made up of small red orbs in a brown or yellow body or gray or brown orbs in a dark-brown body. Donor: W. C. Eyles.

Lapis Lazuli—from near Ontario, San Bernardino County. This particular sample is azure-blue in a white matrix which cuts and polishes well and resembles Chilean lapis.

Malacuprite (malachite and cuprite)—from the Mojave Desert, San Bernardino County. This deep-green mineral with lines of chocolate brown cuts and polishes well and is very attractive. Donor: F. J. Sperisen.

Mariposite—from near Coulterville, Mariposa County. This is an emerald-green mineral in a body of white quartz and calcite. Although free from fractures, this specimen did not polish well as expected owing to varying hardness. Donor: C. McK. Laizure.

Myrickite (cinnabar in chalcedony)—from 18 miles southeast of San Jose, near Coyote, Santa Clara County. This material is a cinnabar-red and takes a fine polish. Only small cut stones could be made as the rough piece was full of cavities.

Obsidian, Iridescent—from Volcanic Mountain, south of Coso Hot Springs, Inyo County. When cut and polished this material holds its iridescence. When looked at from one angle it appears to be shiny black, but from the opposite direction it has a gray and blue cat's-eye effect, with a pearly luster. Donor: J. H. Joyner.

Obisidian, Iridescent—from Davis Creek, Modoc County. This is in large pieces of rough material and shows a purple iridescence but when cut and polished it loses most of the iridescence but has a black cat's-eye effect. Donor: Donald C. Wright.

Onyx, California (onyx marble)—the specimens on display are translucent, having a golden yellow color with streaks of brown. Donor: W. C. Eyles.

Petrified Palm Root—from near Randsburg, Kern County. This specimen is a gray chalcedony; when cut across a piece of root, it shows all the fibers.

Picrolite (a variety of serpentine)—from somewhere in California. It was sent to the laboratory for classification. When polished this stone has a gray-green with cat's-eye effect and a satiny luster.

Prase (green chert)—from Laytonville, Mendocino County. This specimen is a grayish-green chert well silicified and has an even texture.

Rhodonite—from Indian Creek, Happy Camp, Siskiyou County. A deep-pink mineral streaked with black; which cuts and polishes well and is most beautiful.

Rock Crystal (clear quartz)—from Calaveras County.

Rose Quartz—from Baker Meadow, Tulare County. This has a deep-rose color and is very clear. When cut properly it shows asterism. Our piece was quite badly fractured. Donor: H. Nordin.

Rose Quartz—from Lassen County. This specimen is the milky variety of a light-pink color and fairly free from fractures. Donor: C. W. Fisher.

Sanbornite (white) with *Gillespite* (red) from near Incline, Mariposa County. This is a white body with dabs of clear and blood-red, with a pearly luster.

Serpentine—from Tuolumne County. This polishes to an olive-green with a waxy luster and fairly free from fractures. Donor: H. Nordin.

Silicified Limonite—from Sheep Ranch, Calaveras County. A very nice brown color and shows the banding of the limonite, but well silicified and takes a good polish.

Native *Silver* in *Calcite* reported to be from El Dorado County. This material cuts and polishes to rather spectacular stones being mostly silver with a small amount of white of the calcite. Donor: W. C. Eyles.

Tourmaline—from Mesa Grande, San Diego County. These specimens are cut cabochon and have a pale-blue color, one having brown stripes.

Turquoise—from near Goldstone, San Bernardino County. These specimens tend toward the color of variscite and are of a good quality material from which fair-sized stones can be cut without any matrix.

LABORATORY

Frank Sanborn, Mineral Technologist

The laboratory of the Division of Mines is maintained for the purpose of identifying minerals and making qualitative analyses of rocks. These determinations and analyses are made without cost to those who seek the services of this state department. Ordinarily, a small sample weighing not over half a pound, in the lump form if possible, should be submitted with a letter stating what particular tests are desired, if there is a special reason for sending the material. Not more than three samples should be sent at one time, nor is it necessary to send more than one. Information regarding the size of the deposit and its proximity to rail transportation is useful in determining the possible value of a mineral body.

When requested, assistance in finding a market for a mineral will be given. When such help is desired, a small representative sample of the material for which a market is sought should accompany the request. The Division is often able to send a very small sample of a particular mineral for comparative purposes to any earnest prospector. Very small pieces of certain silicates, such as andalusite, have been supplied to those desiring them.

Several thousand determinations are made annually by the Division of Mines, and prospecting and exploitation of the State's mineral wealth increases as the State becomes more thickly populated. Each year new occurrences of some mineral in the State are reported, and occasionally a new mineral species is found. New uses for a mineral are frequently found, and as a result stimulus is given to searching for that particular substance.

LIBRARY

HERBERT A. FRANKE, Librarian

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines contains over six thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, CALIFORNIA JOURNAL OF MINES AND GEOLOGY contains under this heading a list of all books and official reports and bulletins received which pertain particularly to mining in California.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED WHICH ARE OF INTEREST ESPECIALLY TO CALIFORNIA MINING

U. S. Geological Survey.

Water-Supply Papers:

679-A—The Thiem Method for Determining Permeability of Water-Bearing Materials. By L. K. Wenzel.

Topographic Maps:

Macdoel Quadrangle, Siskiyou County.

U. S. Bureau of Mines.

Monographs:

7—Back Pressure Data on Natural-Gas Wells and Their Application to Production Practices. By E. L. Rawlins and M. A. Schellhardt.

Technical Papers:

567—Preventing Accidents by the Proper Use of Permissible Explosives. By D. Harrington and S. P. Howell.

Information Circulars:

6875—Sand and Gravel Excavation: Part 5: Motor-Truck Haulage, Conveyor-Belt Haulage, Pumps and Pipe Lines, Barges and Towboats, Aerial Trams. By J. R. Thoenen.
6877—Progress Report on Investigation of Detachable Rock-Drill Bits. By McHenry Mosier.
6879—Sand and Gravel Excavation. Part 6: Mining Methods. By J. R. Thoenen.
6881—Trends in White-Pigment Consumption. By Paul M. Tyler.
6882—Alums and Aluminum Sulphate. By John B. Umhau.
6883—Patents on Geophysical Prospecting issued in the United States, England, Canada, Australia, Germany, France and Russia. By W. Ayvazaglou.

U. S. Bureau of Foreign and Domestic Commerce:

Foreign Metals and Minerals.

New Books Received in State Division of Mines Library:

Morrison's Mining Rights. By E. D. De Soto and A. R. Morrison.
Yearbook of the American Bureau of Metal Statistics, 1935.

New Books Received by John Hays Hammond Public Mining Library:

Practical Mine Development and Equipment. By L. Eaton.
Publications Received Currently and Former Reports Available for Reference.

Governmental, National.

U. S. Geological Survey:

Bulletins, Water-Supply Papers, Annual Reports, Professional Papers, Circulars, Monographs, Topographic Maps, and Special Publications.

U. S. Bureau of Mines:

Bulletins, Technical Papers, Economic Papers, Mineral Trade Notes, Reports of Investigations, Information Circulars and Miners' Circulars.

Governmental, State.

Alabama Geological Survey, University.
Arizona Bureau of Mines, Tucson.
Arkansas Geological Survey, Little Rock.
Colorado Bureau of Mines, Denver.
Connecticut Geological and Natural History Survey, Hartford.
Florida Department of Conservation, Tallahassee.
Georgia Division of Geology, Atlanta.
Idaho Bureau of Mines and Geology, Moscow.
Illinois Geological Survey, Urbana.
Indiana Division of Geology, Indianapolis.
Iowa Geological Survey, Des Moines.
State Geological Survey of Kansas, Lawrence.
Kentucky Geological Survey, Frankfort.
Louisiana Department of Conservation, New Orleans.
Maine State Geologist, Augusta.
Maryland Geological Survey, Baltimore.
Michigan Geological Survey, Lansing.
Minnesota Geological Survey, Minneapolis.
Mississippi State Geological Survey, University.
Missouri Bureau of Geology and Mines, Rolla.
Montana Bureau of Mines and Geology, Butte.
Nebraska Geological Survey, Lincoln.
Nevada State Bureau of Mines, Reno.
New Jersey Department of Conservation and Development, Trenton.
New Mexico Bureau of Mines and Mineral Resources, Socorro.
North Carolina Geological and Economic Survey, Chapel Hill.
North Dakota Geological Survey, Grand Forks.
Ohio Geological Survey, Columbus.
Oklahoma Geological Survey, Norman.
Oregon Bureau of Mines and Geology, Corvallis.

Pennsylvania Topographic and Geological Survey, Harrisburg.
South Dakota State Geological Survey, Vermillion.
Tennessee Division of Geology, Nashville.
Texas Bureau of Economic Geology, Austin.
Virginia Geological Survey, University.
Washington State Department of Conservation and Development, Pullman.
West Virginia Geological Survey, Morgantown.
Wisconsin Geological and Natural History Survey, Madison.
Wyoming Geological Survey, Cheyenne.

Governmental, Foreign.

Alberta Research Council, Edmonton.
Argentina Direccion General de Minas y Geologica, Buenos Aires.
British Columbia Minister of Mines, Victoria.
British Museum and Natural History, London.
Canada Department of Mines, Ottawa.
Cuerpo de Ingenieros de Minas y Aguas del Peru, Lima.
Geological Service of Minas Geraes, Bella Horizonte, Brazil.
Geological Survey of Scotland.
Instituto Historica e Geographico Rio de Janeiro.
Museo de Historia Natural de Montevideo, Uruguay.
New South Wales Department of Mines, Sydney, Australia.
New Zealand Geological Survey Branch, Wellington.
Nova Scotia Department of Public Works and Mines, Halifax.
Ontario Department of Mines, Toronto, Canada.
Quebec Bureau of Mines, Quebec.
Queensland Department of Mines, Brisbane, Australia.
South Australia Department of Mines, Adelaide.
Western Australia Geological Survey, Perth.
Transvaal Chamber of Mines, Johannesburg, South Africa.

Societies and Educational Institutions.

Academia de Ciencias y Artes de Barcelona, Spain.
Academy of Natural Sciences of Philadelphia.
American Association of Petroleum Geologists, Tulsa, Oklahoma.
American Geographical Society of New York.
American Institute of Mining and Metallurgical Engineers, New York.
American Journal of Science, New Haven, Conn.
American Philosophical Society, Philadelphia.
Australian Museum, Sydney.
California Academy of Sciences, San Francisco.
Canadian Institute of Mining and Metallurgy, Montreal.
Carnegie Institution of Washington.
Cleveland Museum of Natural History, Cleveland, Ohio.
Colorado College Publications, Colorado Springs.
Colorado Scientific Society, Denver.
Commonwealth Club, San Francisco.
Economic Geology, Lancaster, Pa.
Field Museum of Natural History, Chicago.
Franklin Institute of the State of Pennsylvania, Lancaster, Pa.
Geological Society of America, Columbia University, New York.
Geographical Society of London.
Institution of Mining and Metallurgy, London.
Instituto Geologico de Mexico, Mexico, D. F.
Journal of Geology, Chicago.
Mineralogical Society of America, Menasha, Wisconsin.
Michigan College of Mining and Technology, Houghton.
Mining and Metallurgical Society of America, New York.
Museu Nacional, Rio de Janeiro.
National Research Council, Washington, D. C.
New York Academy of Sciences, New York.
New York State Museum, Albany.
Pennsylvania State College, State College.

Philippine Journal of Science, Manila.
Royal Society of South Australia, Adelaide.
Seismological Society of America, Stanford University.
Sierra Club, San Francisco.
Society of Economical Paleontologists and Mineralogists, Fort Worth, Texas.
Southern California Academy of Sciences, Los Angeles.
University of California Publications in Engineering, Berkeley.
University of California Publications in Geography, Berkeley.
University of California Publications in Geology, Berkeley.
University of Harvard, Department of Mineralogy and Petrography, Cambridge, Mass.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
California Journal of Development, San Francisco.
California Mining Journal, Auburn.
California Oil World, Los Angeles.
California Safety News, San Francisco.
Canadian Mining Journal, Gardenvale, Quebec.
Chemical and Metallurgical Engineering, New York City.
Chemical Engineering and Mining Review, Melbourne, Australia.
Commonwealth, San Francisco.
Colorado School of Mines, Golden, Colorado.
Engineering and Mining Journal, New York City.
Fuel Oil, Chicago, Illinois.
Fusion Facts, Whittier, California.
Gemmologist, London.
Gold, Toronto, Canada.
Grizzly Bear, Los Angeles.
Hercules Mixer, Wilmington, Delaware.
Lubrication, The Texas Co., New York City.
Metals and Alloys, Pittsburgh, Pa.
Mineralogist, Portland, Ore.
Mining Congress Journal, Washington, D. C.
Mining Journal, London.
Mining Journal, Phoenix, Arizona.
Mining and Industrial News, San Francisco.
Mining and Metallurgy, New York City.
Mining Review, Salt Lake City.
Nickel Cast Iron News, New York City.
Northwest Mining, Spokane, Washington.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York City.
Oil Weekly, Houston, Texas.
Pacific Purchaser, San Francisco.
Petroleum World, Los Angeles.
Pit and Quarry, Chicago.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago.
Rocks and Minerals, Peekskill, New York.
Sands, Clays and Minerals, Chatteris, England.
Scientific American, New York City.
Southwest Builder and Contractor, Los Angeles.
Stabilizer, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York City.
Western Mining News, San Francisco

Newspapers.

The following papers are received and kept on file in the library:

Alaska Weekly, Seattle, Washington.
Amador Dispatch, Jackson, California.
Banner, Sonora, California.
Barstow Printer, Barstow, California.
Bridgeport Chronicle-Union, Bridgeport, California.
Calaveras Californian, Angels Camp, California.
Calaveras Prospect, San Andreas, California.
Colusa Sun-Herald, Colusa, California.
Daily Commercial News, San Francisco, California.
Del Norte Triplicate, Crescent City, California.
Denver Mining Record, Denver, Colorado.
Georgetown Gazette, Georgetown, California.
Inland Oil Index, Casper, Wyoming.
Inyo Independent, Independence, California.
Inyo Register, Bishop, California.
Las Vegas Age, Las Vegas, Nevada.
Livermore Herald, Livermore, California.
Los Angeles Times, Los Angeles, California.
Mariposa Gazette, Mariposa, California.
Mercury Register, Oroville, California.
Mojave Miner, Kingman, Arizona.
Mojave-Randsburg Record, Mojave, California.
Morning Union, Grass Valley, California.
Mountain Messenger, Downieville, California.
Needles Nugget, Needles, California.
Nevada City Nugget, Nevada City, California.
Nevada Mining Bulletin, Las Vegas, Nevada.
Oil Marketer, Bayonne, New Jersey.
Placer Herald, Auburn, California.
Plumas Independent, Quincy, California.
Randsburg Times, Randsburg, California.
Shasta Courier, Redding, California.
Siskiyou News, Yreka, California.
Stockton Record, Stockton, California.
Tehachapi News, Tehachapi, California.
Terra Bella News, Terra Bella, California.
Tuolumne Independent, Sonora, California.
Tuolumne Prospector, Tuolumne, California.
Union Democrat, Sonora, California.
Weekly Trinity Journal, Weaverville, California.
Western Mineral Survey, Salt Lake City, Utah.
Western Sentinel, Etna Mills, California.
Yreka Journal, Yreka, California.

PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by this Division to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of *Mining in California* was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of California Journal of Mines and Geology, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list of California Journal of Mines and Geology.

EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.

PUBLICATIONS OF THE DIVISION OF MINES

During the past fifty-six years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the State, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have usually been limited, the reports and bulletins mentioned are printed in limited editions many of which are now entirely exhausted.

Copies of such publications are available for reference, however, in the offices of the Division of Mines, in the Ferry Building, San Francisco; State Building, Los Angeles; State Office Building, Sacramento; Redding; and Division of Oil and Gas at Santa Barbara, Taft, Bakersfield, Coalinga. They may also be found in many public, private and technical libraries in California and other States and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

Money orders should be made payable to Division of Mines.

Purchasers in California add 3 per cent sales tax.

NOTE.—The Division of Mines frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

Asterisks (**) indicate the publication is out of print.

	Price[a]	Shipping Charges
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----	----
Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	$0.50	$0.10
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----	----
Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	1.00	.15
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	1.00	.20
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:		
Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	.50	.10
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50	.10
Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	.25	.10
Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pp., paper	.50	.10
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35	.10
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915: A general Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:		
Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	.65	.10
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	.50	.05
Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper	.65	.10
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper	.65	.10
Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	.50	.10
Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	.65	.10

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[a] Purchasers in California add 3 per cent sales tax.

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917; A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1917–1918, Fletcher Hamilton:		
Mines and Mineral Resources of Nevada County, 270 pp., paper	$0.75	$0.15
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50	.10
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50	.10
Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75	.25
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:		
**January, **February, **March, April, **May, June, July, August, September, October, **November, December, 1922	.25	.05
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	.25	.05
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy	.25	.05
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties	.25	.05
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties	.25	.05
**July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.25	.10
**October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties	----	----
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
**January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties	.25	.10
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial Counties	.25	.10
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties	.25	.05
**October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	----	----
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island	.25	.10
April, 1927, Mines and Mineral Resources of Amador and Solano Counties	.25	.05
**July, 1927, Mines and Mineral Resources of Placer and Los Angeles Counties	.25	.10
October, 1927, Mines and Mineral Resources of Mono County	.25	.05
Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1928, Mines and Mineral Resources of Tuolumne County	.25	.05
April, 1928, Mines and Mineral Resources of Mariposa County	.25	.05
July, 1928, Mines and Mineral Resources of Butte and Tehama Counties	.25	.05
October, 1928, Mines and Mineral Resources of Plumas and Madera Counties	.25	.05
Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**January, 1929, Mines and Mineral Resources of Lassen, Modoc and Kern Counties; also on Special Placer Machines	----	----
April, 1929, Mines and Mineral Resources of Sierra, Napa, San Francisco and San Mateo Counties	$0.25	$0.10
July, 1929, Mines and Mineral Resources of Colusa, Fresno and Lake Counties	.25	.10
October, 1929, Mines and Mineral Resources of Glenn, Alameda, Mendocino and Riverside Counties	.25	.10
Chapters of Twenty-sixth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1930, Mines and Mineral Resources of Santa Clara County; also Barite in California	.25	.05
**April, 1930, Mines and Mineral Resources of Nevada County; also Mineral Paint Materials in California	.25	.05
July, 1930, Mines and Mineral Resources of Yuba and San Bernardino Counties; also Commercial Grinding Plants in California	.25	.10
October, 1930, Mines and Mineral Resources of Butte, Kings and Tulare Counties; also Geology of Southwestern Mono County (Preliminary)	.25	.10
Chapters of Twenty-seventh Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1931, Preliminary Report on Economic Geology of the Shasta Quadrangle. Beryllium and Beryl. The New Tariff and Nonmetallic Products. Crystalline Talc. Decorative Effects in Concrete	.25	.10
April, 1931, Stratigraphy of the Kreyenhagen Shale. Diatoms and Silicoflagellates of the Kreyenhagen Shale. Foraminifera of the Kreyenhagen Shale. Geology of Santa Cruz Island	.25	.10
**July, 1931. (Yuba, San Bernardino.) Feldspar, Silica, Andalusite and Cyanite Deposits of California. Note on a Deposit of Andalusite in Mono County; its occurrence and chemical importance. Bill creating Trinity and Klamath River Fish and Game District and its effect upon mining	.25	.10
October, 1931. (Alpine.) Geology of the San Jacinto Quadrangle south of San Gorgonio Pass, California. Notes on Mining Activities in Inyo and Mono Counties in July, 1931	.25	.05
Chapters of Twenty-eighth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1932, Economic Mineral Deposits of the San Jacinto Quadrangle. Geology and Physical Properties of Building Stone from Carmel Valley. Contributions to the Study of Sediments. Sediments of Monterey Bay. Sanbornite	.25	.10
**April, 1932. Elementary Placer Mining Methods and Gold Saving Devices. The Pan, Rocker and Sluice Box. Prospecting for Vein Deposits. Bibliography of Placer Mining	----	----
Abstract from April quarterly: Elementary Placer Mining Methods and Gold Saving Devices. Types of Deposits, Simple Equipment. Special Machines. Dry Washing. Black Sand Treatment. Marketing of Products. Placer Mining Areas. Laws. Prospecting for Quartz Veins. Bibliography (mimeographed)	.20	.05
July-October. (Ventura.) Report accompanying Geologic Map of Northern Sierra Nevada. Fossil Plants in Auriferous Gravels of the Sierra Nevada. Glacial and Associated Stream Deposits of the Sierra Nevada. Juarassic and Cretaceous Divisions in the Knoxville-Shasta Succession of California. Geology of a Part of the Panamint Range. Economic Report of a Part of the Panamint Range. Acquiring Mining Claims Through Tax Title. The Biennial Report of State Mineralogist	.50	.15
Chapters of Report XXIX, 1933 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
January-April. Gold Deposits of the Redding and Weaverville Quadrangles. Geologic Formations of the Redding-Weaverville District, Northern California. Geology of Portions		

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
of Del Norte and Siskiyou Counties. Applications of Geology to Civil Engineering. The Lakes of California. Discovery of Piedmontite in the Sierra Nevada. Tracing 'Buried River' Channel Deposits by Geomagnetic Methods. Geologic Map of Redding-Weaverville District, showing gold mines and prospects. Geologic Map showing various mines and prospects of part of Del Norte and Siskiyou Counties	$0.80	$0.15
July-October. Gold Resources of Kern County. Limestone Deposits of the San Francisco Region. Limestone Weathering and Plant Associations of the San Francisco Region. Booming. Death Valley National Monument, California. Placer Mining Districts, Senate Bill 480. Navigable Waters, Assembly Bill 1543	.80	.10
Chapters of Report XXX, 1934 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
January. Resurrection of Early Surfaces in the Sierra Nevada. Geology and Mineral Resources of Northeastern Madera County. Geology and Mineral Deposits of Laurel and Convict Basins, Southwestern Mono County. Notes on Sampling as Applied to Gold Quartz Deposits	.40	.10
April-July. Elementary Placer Mining in California and Notes on the Milling of Gold Ores	.80	.10
October. Current Mining Developments in Northern California. Current Mining Activity in Southern California. Geology and Mineral Resources of the Julian District, San Diego County. Geology and Mineral Resources of Elizabeth Lake Quadrangle. Dry Placers of Northern Mojave Desert. Biennial Report of State Mineralogist. Assessment Work Within Withdrawn Areas	.40	.10
Chapters of Report XXXI, 1935 (quarterly): titled "California Journal of Mines and Geology"		
January. Review of Gold Mining in East-Central, 1934. Current Mining Activities in the San Francisco District with Special Reference to Gold. Geological Investigation of the Clays of Riverside and Orange Counties, Southern California. Information regarding Mining Loans by the Reconstruction Finance Corporation	.40	.10
April. A Geologic Section Across the Southern Peninsular Range of California. New Technique Applicable to the Study of Placers. Grubstake Permits	.40	.10
July. Mines and Mineral Resources of Siskiyou County (with map). Dams for Hydraulic Mining Debris. Leasing System as Applied to Metal Mining. Mine Financing in California. New Laws Make Radical Change in Mining Rights	.40	.10
October. Mines and Mineral Resources of San Luis Obispo County. Mineral Resources of Portions of Monterey and Kings Counties. Mining Activities at Soledad Mountain and Middle Buttes-Mojave District, Kern County. Geology of a Portion of the Perris Block, Southern California. Mineral Resources of a Portion of the Perris Block, Riverside County	.40	.10
Chapters of Report XXXII, 1936 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
January (Placer Co., gold mines of), includes a description of drag-line dredgers and their operations; Geologic Report on Borax Lake	.40	.10
April. Geology, mining and processes of diatomite at Lompoc, Santa Barbara Co.; Essentials in developing and financing a prospect into a mine; Gold-bearing veins of Meadow Lake District, Nevada Co.; California semi-precious gem stones (in press)	.40	.10
July (Calaveras Co.) (in press)	.40	.10
Subscription, $1.75 postpaid, in advance (by calendar year only).		
Chapters of State Oil and Gas Supervisor's Report:		
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free	----

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:		
**April, **May, **June, **July, **August, **September, **October, **November, **December, 1919	----	----
**January, **February, **March, **April, **May, **June, **July, **August, **September, **October, **November, **December, 1920	----	----
January, **February, **March, April, **May, **June, **July, August, **September, **October, **November, **December, 1921	Free	----
January, February, March, April, May, June, **July, **August, September, **October, **November, December, 1922	Free	----
January, February, **March, **April, May, **June, **July, August, September, **October, November, **December, 1923	Free	----
January, February, March, April, May, June, **July, August, September, October, November, December, 1924	Free	----
January, February, March, April, May, June, July, August, September, October, November, December, 1925	Free	----
January, February, March, April, May, June, July, August, September, October, November, December, 1926	Free	----
January, February, March, April, May, June, July, August, September, October, November, December, 1927	Free	----
January, February, March, April, May, June, July, August, September, October, **November, **December, 1928	Free	----
January, February, March, April, May, June, July-August-September, October-November-December, 1929	Free	----
(Published quarterly beginning July, 1929.)		
January-February-March, April-May-June, July-August-September, October-November-December, 1930	Free	----
January-February-March, April-May-June, July-August-September, 1931	Free	----
January, February, March, April, May, June, July, August, September, October, November, December, 1932	Free	----
January, February, March, 1933	Free	----
April, May, June, 1933	Free	----
July, August, September, 1933	Free	---

BULLETINS

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----	----
**Bulletin No. 4. Catalogue of California Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887)	----	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----	----
**Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations	----	----
**Bulletin No. 7. Mineral Production of California, by Counties, for the year 1894, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 8. Mineral Production of California, by Counties, for the year 1895, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----	----
**Bulletin No. 10. A Bibliography Relating to the Geology, Paleontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara Counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----	----
**Bulletin No. 12. Mineral Production of California, by Counties, for 1896, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 13. Mineral Production of California, by Counties, for 1897, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 14. Mineral Production of California, by Counties, for 1898, by Charles G. Yale	----	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means, 1899	----	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----	----
**Bulletin No. 17. Mineral Production of California, by Counties, for 1899, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations	----	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----	----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet	----	----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----	----
**Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, 9 maps	----	----
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps	----	----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 26. Mineral Production of California for the Past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet	----	----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps	----	----
**Bulletin No. 28. Mineral Production of California for 1902, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet	----	----
**Bulletin No. 30. Bibliography Relating to the Geology, Paleontology and Mineral Resources of California, by A. W. Vogdes. 1933, 290 pp.	----	----

BULLETINS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet	----	----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps	----	----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet	----	----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California	----	----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905. 120 pp., 66 illustrations, 3 maps	----	----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905, 168 pp., 54 illustrations	----	----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map	----	----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet	----	----
**Bulletin No. 41. Mines and Minerals of California for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps	----	----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	----	----
**Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	----	----
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 48. Mineral Production of California for Twenty Years, by Charles G. Yale. 1906	----	----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----	----
Bulletin No. 50. The Copper Resources of California, 1908, by A. Hausmann, J. Kruttschnitt, Jr., W. E. Thorne and J. A. Edman. 366 pp., 74 illustrations. (Revised edition)	$1.00	$0.25
**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet	----	----
**Bulletin No. 52. Mineral Production of California for Twenty-one Years, by D. H. Walker. 1907. Tabulated sheet	----	----
**Bulletin No. 53. Mineral Production of California for 1907, with County Maps, by D. H. Walker. 62 pp.	----	----
**Bulletin No. 54. Mineral Production of California, by Counties, by D. H. Walker, 1908. Tabulated sheet	----	----
**Bulletin No. 55. Mineral Production of California for Twenty-two Years, by D. H. Walker, 1908. Tabulated sheet	----	----
**Bulletin No. 56. Mineral Production for 1908, with County Maps and Mining Laws of California, by D. H. Walker, 78 pp.	----	----
**Bulletin No. 57. Gold Dredging in California, by W. B. Winston and Chas. Janin. 1910, 312 pp., 239 illustrations, 10 maps	----	----
**Bulletin No. 58. Mineral Production of California, by Counties, by D. H. Walker. 1909. Tabulated sheet	----	----
**Bulletin No. 59. Mineral Production of California for Twenty-three Years, by D. H. Walker. 1909. Tabulated sheet	----	----
**Bulletin No. 60. Mineral Production for 1909, with County Maps and Mining Laws of California, by D. H. Walker. 94 pp.	----	----

BULLETINS—Continued

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**Bulletin No. 61. Mineral Production of California, by Counties, for 1910, by D. H. Walker. Tabulated sheet	----	----
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**Bulletin No. 67. Minerals of California, by Arthur S. Eakle. 1914, 226 pp.	----	----
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**Bulletin No. 72. The Geologic Formations of California, by James Perrin Smith. 1916, 47 pp.	----	----
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Bulletin No. 77. Catalogue of Publications of California State Mining Bureau, 1880–1917, by E. S. Boalich. 44 pp., paper	Free	.05
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†Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)		
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PRELIMINARY REPORTS

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**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin, 4 pp.	----	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	Free	$0.05
Preliminary Report No. 4. Tungsten, Molybdenum and Vanadium. By E. S. Boalich and W. O. Castello, 1918. 34 pp. Paper	Free	.05
Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper	Free	.05
**Preliminary Report No. 6. A Review of Mining in California During 1919. By Fletcher Hamilton, 1920. 43 pp. Paper	----	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----	----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. By Fletcher Hamilton, 1922. 68 pp. Paper	----	----

MISCELLANEOUS PUBLICATIONS

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp., 2 illustrations. Paper	$0.10	----
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free	.15 annually

MAPS

Register of Mines With Maps

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**Register of Mines, with Map, Amador County	----	----
Register of Mines, with Map, Butte County	$0.25	$0.05
**Register of Mines, with Map, Calaveras County	----	----
**Register of Mines, with Map, El Dorado County	----	----
**Register of Mines, with Map, Inyo County	----	----
**Register of Mines, with Map, Kern County	----	----
**Register of Mines, with Map, Lake County	----	----
**Register of Mines, with Map. Mariposa County	----	----
**Register of Mines, with Map, Nevada County	----	----
**Register of Mines, with Map, Placer County	----	----
**Register of Mines, with Map, Plumas County	----	----
**Register of Mines, with Map, San Bernardino County	----	----
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**Register of Mines, with Map, Shasta County	----	----
**Register of Mines, with Map, Sierra County	----	----
**Register of Mines, with Map, Siskiyou County	----	----
**Register of Mines, with Map, Trinity County	----	----
**Register of Mines, with Map, Tuolumne County	----	----
Register of Mines, with Map, Yuba County (1905)	.25	.05
Register of Oil Wells, with Map, Los Angeles City (1906)	.35	.05

OTHER MAPS

**Map of California, Showing Mineral Deposits (50 x 60 in.)	----	----
**Map of Forest Reserves in California	----	----
**Mineral and Relief Map of California	----	----
**Map of El Dorado County, Showing Boundaries, National Forests	----	----
**Map of Madera County, Showing Boundaries, National Forests	----	----
**Map of Placer County, Showing Boundaries, National Forests	----	----
**Map of Shasta County, Showing Boundaries, National Forests	----	----
**Map of Sierra County, Showing Boundaries, National Forests	----	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----	----
**Map of Mother Lode Region	----	----
**Map of Desert Region of Southern California	----	----
Map of Minaret District, Madera County	.20	.05
Map of Copper Deposits in California	.05	----
**Map of Calaveras County	----	----
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**Map of Trinity County	----	----
**Map of Tuolumne County	----	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60	.05
**Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	----	----
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up to date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Unmounted	.75	.05
Mounted	2.50	.15
**Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels, accompanying Bulletin No. 92. In 4 colors (also sold singly)	----	----
Geologic Map of Northern Sierra Nevada, showing Tertiary River Channels and Mother Lode Belt, accompanying July-October Chapter of Report XXVIII of the State Mineralogist. (Sold singly)	.25	.05
Map of Northern California, showing rivers and creeks which produced placer gold in 1932	.20	.05
Mother Lode Geologic and claim maps in 5 county sections: El Dorado, Amador, Calaveras, Tuolumne and Mariposa. Single sections 10c. Set of 5	.50	----
Map of Mariposa County showing principal gold mines	.10	----

OTHER MAPS—Continued

	Price	Shipping Charges
Geologic Map of Elizabeth Lake Quadrangle, Los Angeles and Kern Counties (accompanying October Chapter of Report XXX), sold separately	$.10	----
Map of Western Portion of Siskiyou County, showing location of principal gold mines (accompanying July Chapter of Report XXXI), sold separately	.10	----

OIL FIELD MAPS

The maps are revised from time to time as development work advances and ownerships change.

	Price (including postage)
Map No. 1—Sargent, Santa Clara County	$0.50
Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	1.00
Map No. 3—Santa Maria, including Casmalia and Lompoc	1.00
Map No. 4—Brea Olinda & (East Portion) Coyote Hills, Los Angeles and Orange Counties	1.00
Map No. 6—Salt Lake-Beverly Hills, Los Angeles County	1.00
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Map No. 12—Devils Den, Kern County	.75
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Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach, Los Angeles County	1.50
Map No. 21—Portion of District No. 4, showing boundaries of oil fields—Kern and Kings Counties	.75
Map No. 21-A—Portion of District No. 4 showing boundaries of oil fields—Kern County	.75
Map No. 21-B—Portion of District No. 5, showing boundaries of oil fields—Fresno, Kings and Kern Counties	.75
Map No. 22—Portion of District No. 3, showing boundaries of oil fields—Santa Barbara County	.75
Map No. 23—Portion of District No. 2, showing boundaries of oil fields—Ventura County	.75
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Map No. 39—West Coyote, Los Angeles and Orange Counties	1.00
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Map No. 41—Potrero, Los Angeles County	.75
Map No. 42—Playa del Rey, Los Angeles County	1.25
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Map No. 44—Mesa, Santa Barbara County	1.25
Map No. 45—Buttonwillow gas, Kern County	.75
Map No. 46—Richfield, Orange County	1.00
Map No. 47—Mountain View, Kern County	.75
Map No. 48—Mountain View and Edison, Kern County	1.25

DETERMINATION OF MINERAL SAMPLES

Samples (limited to one at one time) of any mineral found in the State may be sent to the Division of Mines for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the State. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

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STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
GEORGE D. NORDENHOLT, Director

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY State Mineralogist

Vol. 32 JULY, 1936 No. 3

CALIFORNIA JOURNAL
OF
MINES AND GEOLOGY

QUARTERLY CHAPTER
OF
STATE MINERALOGIST'S REPORT XXXII

STATE DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO
CALIFORNIA

34726

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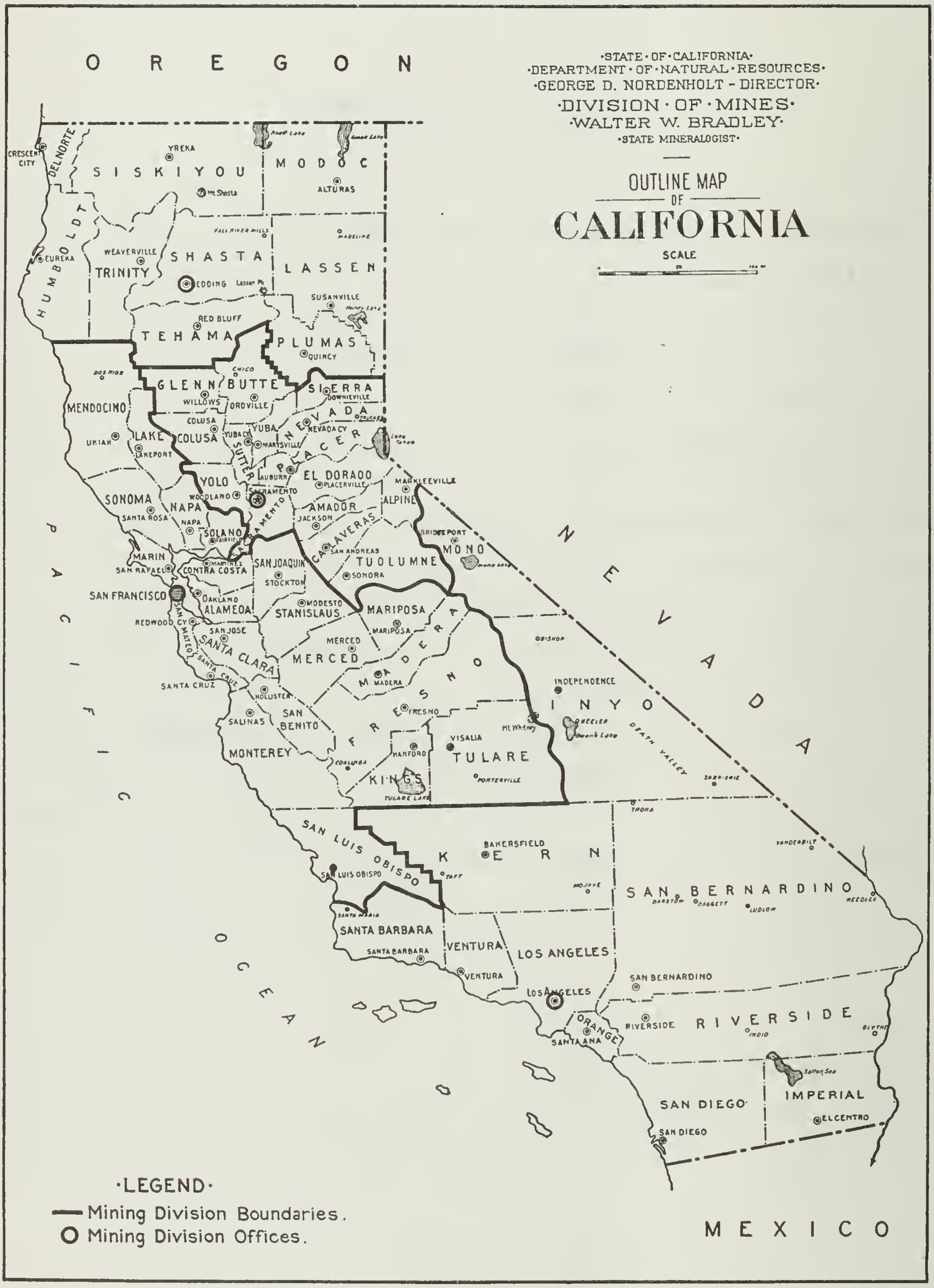
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DEPARTMENT · OF · NATURAL · RESOURCES
GEORGE D. NORDENHOLT - DIRECTOR
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STATE MINERALOGIST
OUTLINE MAP
OF
CALIFORNIA
SCALE
OREGON
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PACIFIC OCEAN
DEL NORTE
CRESCENT CITY
SISKIYOU
YREKA
Mt Shasta
MODOC
ALTURAS
HUMBOLDT
EUREKA
TRINITY
WEAVERVILLE
SHASTA
REDDING
Lassen Pk
LASSEN
SUSANVILLE
TEHAMA
RED BLUFF
PLUMAS
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OAKLAND
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STANISLAUS
MODESTO
MARIPOSA
REDWOOD CY
SAN MATEO
SAN JOSE
SANTA CLARA
SANTA CRUZ
MERCED
MADERA
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HOLLISTER
SAN BENITO
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MONTEREY
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INDEPENDENCE
BISHOP
Mt Whitney
KEELER
Owens Lake
DEATH VALLEY
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HANFORD
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LOS ANGELES
SAN BERNARDINO
ORANGE
SANTA ANA
RIVERSIDE
INDIO
BLYTHE
Salton Sea
SAN DIEGO
IMPERIAL
EL CENTRO
·LEGEND·
Mining Division Boundaries.
Mining Division Offices.

PREFACE

The Division of Mines (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

As a progressive step in advancing the interests of the mineral industry, and as permitting earlier distribution to the public, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923. Owing to a lack of funds for printing this was changed to a quarterly publication, beginning in September, 1923. For the same reason, beginning with the January, 1924, issue, it became necessary to charge a subscription price. This covers approximately the cost of printing.

Pages are numbered, consecutively throughout the year and an index to the complete report is included annually in the closing number.

Beginning with the 1930 issues, the activities and progress of the Geological Branch are recorded also in these quarterly chapters. The important part that geology plays in the economic development of our mineral resources is further recognized in the change of title from *Mining in California* to CALIFORNIA JOURNAL OF MINES AND GEOLOGY, beginning with the January, 1933, chapter.

While current activities of all descriptions are covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters are subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

Types of Reports

In general the reports presented in these chapters are grouped into three classes:

1. Mines and mineral resources of a given county (describing kind, character, distribution and extent of development).
2. Specific economic and industrial mineral products (listing and describing the resources over the entire state of a given mineral substance, e.g. feldspar).
3. Geological reports on specific areas (recording results and conclusions, with maps, derived from field studies; and tied in with economic possibilities, and developments).

REPORTS OF DISTRICT MINING ENGINEERS

In 1919–1920 the Mining Bureau was organized into four main geographic divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work, including lower traveling-expense bills for the Bureau's engineers. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions and the location of the branch offices are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each district, prepared by the District Engineer, will continue to appear under the proper field division heading.

REDDING FIELD DISTRICT

CHAS. VOLNEY AVERILL, Mining Engineer

There is no report from the Redding Field District. Mr. Chas. V. Averill, District Mining Engineer, is engaged on investigations for new reports upon the mines and mineral resources of Plumas, Lassen and Modoc counties.

SACRAMENTO FIELD DISTRICT

MINES AND MINERAL RESOURCES OF CALAVERAS COUNTY

By C. A. Logan[1] and Herbert Franke[2]

Foreword.

The present report is intended to record particularly the recent activities in gold mining in Calaveras County, as observed by Herbert A. Franke in the fall of 1935 and early in 1936. A description of a Portland cement plant, which has been erected since the publication of this division's last report on the mines of the county, and the only recent development of importance outside of gold mining, is also included, as well as short notes on other minerals.

Next to gold, copper has been in the past the most important mineral product of the county. While copper had been known to exist in the state in the 1850's, it was the discovery of the Quail Hill No. 1 and the Napoleon Mine in southwestern Calaveras County in 1860 that initiated the first commercial production of the metal. In later years, Copperopolis and Campo Seco become the principal copper-producing centers. Production was carried on almost continuously from 1894 to 1930, and during the 36 years amounted to over 112,000,000 lbs. Practically no copper has been mined in the county since 1930.

Other minerals produced on a small scale include asbestos, ocher, clay, mineral water, quartz crystals, limestone, chromite, platinum-group metals, lead and miscellaneous stone. Among these, probably the one of most interest scientifically was the discovery of unusually large crystals of clear quartz in the Green Mountain drift mine near Mokelumne Hill. Between 1897 and 1918, about 22 tons of rock crystal was shipped from this mine.

Nearly all of the mines descriptions herein have been written by Herbert A. Franke, junior mining engineer in the San Francisco office of the Division of Mines, with some changes by C. A. Logan, district mining engineer, Sacramento, who has also prepared the summaries of geology of the quartz mining and placer districts.

ASBESTOS

A good quality of chrysotile asbestos occurs in a serpentine belt in Secs. 15, 16, and 21, T. 1 N., R. 13 E., 7 miles southeast of Copperopolis. The fiber is from ½-inch to 1½ inches in length. The following companies have spent considerable money at intervals since 1904 in efforts to expoit the asbestos deposits: *Asbestos Producing Company of California, American Asbestos and Manufacturing Company, American Asbestos Products Company, California Asbestos Company* and *Pacific Asbestos Corporation.* J. H. Bowie, Cooperopolis, is agent for all of the above named companies.

A Mr. Sample, Harry Leach, and others of Oakland, leased the property of the Asbestos Producing Company of California in 1927, and erected an experimental mill. Their equipment included an Austin No. 3 gyratory crusher, Brainard hammer mill, and a 210-cu. ft. Fairbanks-Morse air compressor, which remain on the property. They mined and milled some ore during their 6 months operation, shipping it to Oakland for use in an acoustical and fireproof plaster.

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[1] District Mining Engineer, Sacramento.
[2] Junior Mining Engineer, San Francisco.

Another, short-fiber asbestos deposit occurs about 3½ miles north of Copperopolis, ¾ mile southeast of the old Nassau copper mine, and is known as the *Turner and Lloyd Prospect.* Dr. H. C. Turner and the heirs of Jarvis Lloyd, San Andreas, are the owners.

Bibl.: State Mineralogist's Report XIV, p. 55; XVIII, pp. 98–99; XXI, pp. 163–164.

Undeveloped asbestos is said to occur in serpentine on Mrs. J. Nuland's Ranch and Mrs. Nellie Nuner's Ranch, about 1 mile north of San Andreas.

CEMENT

Calaveras Cement Company's plant and quarries, comprising about 1400 acres in Secs. 19, 20, 25, 27 to 36 inclusive, T. 4 N., R. 12 E., Secs. 11, 29, 30 and 31, T. 4 N., R. 13 E., and Sec. 22, T. 4 N., R. 11 E., are about 2½ miles south of San Andreas. Officers of the company, the address of which is 315 Montgomery Street, San Francisco, are: William Wallace Mein, president; Stuart L. Rawlings, executive vice president; Arthur B. Shelby, vice president and general manager; Geo. B. Poore, vice president; Joe Tedesco, secretary; and J. B. Smith, treasurer. Robert H. Townsend is general mine and plant superintendent. H. J. Dunton is chief chemist and H. C. Maginn is sales manager.

The limestone deposits of this area were brought to the attention of W. W. Mein and S. L. Rawlings by William Macnider in the summer of 1923. Examinations of the property followed, and construction of the plant started in 1925. The cement plant commenced operating in June, 1926, and has continued to date. Transportation is supplied by a branch railroad of the Southern Pacific which was extended from Valley Springs to the present plant site.

The limestone lenses and shale that supply the plant are found in the Calaveras (Carboniferous) formations, occurring as an isolated area east of Bear Mountain, with a length of about 12 miles and an average width of ½ mile. The area is composed of black clay-slate, quartzite, and limestone lenses. The lens occurring at Kentucky House, a ranch house on the property, is about 1½ miles long. The black slates of the Mariposa formation are west of this narrow area. The strike of the limestone and shale strata is about N. 20° W., and they dip steeply to the east. The limestone varies from dark blue to nearly white in color. Its composition varies at different points, and analyses of high- and low-grade rock, as given in U. S. Bureau of Mines I. C. 6610, are as follows:

	Limestone, per cent	
	High-grade	*Low-grade*
Silica	2.30	37.05
Iron and aluminum-oxides	1.39	16.73
Calcium carbonate	95.57	32.83
Magnesium carbonate	.93	3.63

These grades are used in the proportion required to make a mix.

The limestone and shale are delivered to the plant from the two open face quarries, about 2500 and 2800 feet south, by means of one 18-ton and one 20-ton Plymouth gasoline locomotive, and one 30-ton

MINERAL PRODUCTION OF

Year	Gold, value	Silver, value	Copper		Mineral paint (ochre)		Clay	
			Pounds	Value	Tons	Value	Tons	Value
1880	$320,865	$643	[1]	--------	--------	--------	--------	--------
1881	800,000	1,200	--------	--------	--------	--------	--------	--------
1882	670,000	--------	--------	--------	--------	--------	--------	--------
1883	500,000	--------	--------	--------	--------	--------	--------	--------
1884	485,000	--------	--------	--------	--------	--------	--------	--------
1885	527,538	2,558	--------	--------	--------	--------	--------	--------
1886	639,457	4,926	--------	--------	--------	--------	--------	--------
1887	640,417	1,477	--------	--------	--------	--------	--------	--------
1888	580,000	1,500	--------	--------	--------	--------	--------	--------
1889	592,243	1,071	--------	--------	--------	--------	--------	--------
1890	618,821	2,499	--------	--------	--------	--------	--------	--------
1891	738,883	4,860	--------	--------	--------	--------	--------	--------
1892	794,531	24,441	--------	--------	--------	--------	--------	--------
1893	1,669,192	122	--------	--------	--------	--------	--------	--------
1894	2,119,365	5,183	654,866	$64,951	115	$2,530	--------	--------
1895	1,717,916	77	175,895	16,925	--------	--------	--------	--------
1896	1,546,398	500	87,557	8,990	--------	--------	--------	--------
1897	1,439,861	1,745	--------	--------	150	2,400	--------	--------
1898	1,019,023	3,462	18,400	2,052	100	225	--------	--------
1899	1,265,564	9,813	165,484	27,586	--------	--------	--------	--------
1900	1,649,126	80,762	980,934	150,585	400	3,800	--------	--------
1901	2,024,685	44,687	1,701,389	268,000	125	500	--------	--------
1902	2,072,939	46,234	2,087,501	251,062	259	778	--------	--------
1903	1,904,125	68,280	2,246,675	297,263	200	1,000	--------	--------
1904	1,789,184	65,611	2,592,124	414,399	70	385	100	$100
1905	1,836,816	78,859	3,666,810	572,022	379	1,900	40	300
1906	1,644,234	74,099	5,082,320	956,315	--------	--------	50	250
1907	1,097,974	54,420	3,941,883	609,203	--------	--------	--------	--------
1908	1,378,511	62,727	4,804,446	555,704	50	250	25	250
1909	1,440,511	71,418	5,438,908	690 632	--------	--------	100	500
1910	1,147,705	82 866	7,345,321	778,369	--------	--------	30	250
1911	1,112,315	67,032	6,190,153	773,769	--------	--------	50	200
1912	962,145	70,748	6,125,415	1,010,693	--------	--------	4,281	4,431
1913	1,175,208	61,076	5,063,187	784,794	28	190	2,000	4,500
1914	1,336,875	60,244	4,468,998	594,377	--------	--------	280	280
1915	1,391,134	53,298	4,031,149	705,451	[2]	--------	--------	--------
1916	1,356,120	83,643	6,099,509	1,500,479	--------	--------	--------	--------
1917	1,471,442	87,984	7,720,861	2,107,795	[2]	--------	--------	--------
1918	871,263	84,150	6,762,882	1,670,432	--------	--------	--------	--------
1919	1,550,574	35,876	2,049,330	381,175	--------	--------	--------	--------
1920	1,439,745	16,701	2,112,186	388,642	--------	--------	--------	--------
1921	1.495,758	10,232	[2]	--------	--------	--------	--------	--------

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[1] The Union Mine at Copperopolis was a producer as early as 1861, but there are no detailed, annual figures available for Calaveras County earlier than here shown.

[2] Under 'Unapportioned.'

[3] Includes crushed rock, sand, gravel.

CALAVERAS COUNTY, 1880-1934

Mineral water		Limestone		Quartz crystals, value	Miscellaneous and unapportioned		
Gallons	Value	Tons	Value		Amount	Value	Substance
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
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--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	$18,000	717 tons	$3,583	Pyrites.
--------	--------	--------	--------	17,500	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	--------	--------	
--------	--------	--------	--------	--------	3,500 bbls.	5,500	Lime.
					25 tons	375	Chromite.
--------	--------	3,087	$15,430	10,000	20 tons	300	Chromite.
--------	--------	3,994	7,635	--------	40 tons	280	Chromite.
					13.9 ozs.	250	Platinum.
--------	--------	6,872	16,955	10,000	--------	--------	
--------	--------	14,165	31,446	10,000	--------	--------	
--------	--------	4,590	11,987	--------	--------	$50,075	Unapportioned, 1900-1909.
--------	--------	6,283	16,976	--------	--------	--------	
10,000	$5,000	3,943	11,733	--------	220 lbs.	10	Lead.
7,528	3,764	--------	--------	--------	--------	--------	
					2,500 lbs.	25	Graphite.
11,500	5,500	2,000	1,400	--------	7,006 lbs.	308	Lead.
					--------	9,900	Other minerals.
Totals	--------	44,934	$119,062				
		Miscellaneous stone[3], value					
					650 tons	4,550	Chromite.
15,508	6,517	--------	--------	--------	290 tons	2,618	Fuller's earth.
					30 lbs.	1	Lead.
					9 oz.	294	Platinum.
					163 lbs.	8	Lead.
15,343	5,752	--------	$1,900	--------	--------	4,350	Asbestos, fuller's earth, mineral paint platinum, silica.
					1,636 tons	12,570	Chromite
					7,238 lbs.	499	Lead.
18,255	7,025	--------	2,503	--------	54 oz.	2,453	Platinum.
					--------	300	Other minerals.
					1,613 tons	34,245	Chromite.
					6,395 lbs.	550	Lead.
16,985	7,009	--------	2,700	--------	20 oz.	1,433	Platinum.
					--------	3,922	Clay, fuller's earth, mineral paint, silica, zinc.
					3,830 tons	159,453	Chromite.
10,938	6,069	--------	420	--------	10 oz.	598	Platinum.
					--------	2,067	Asbestos and lead.
					2,019 lbs.	107	Lead.
4,384	1,034	--------	600	--------	8 oz.	1,076	Platinum.
					--------	8,116	Other minerals.
					20 fine oz.	2,002	Platinum.
5,120	512	--------	2,400	[2]	--------	30,048	Quartz crystals and lead
					12 fine oz.	876	Platinum.
2,809	791	--------	17,527	--------	--------	17	Copper and lead

MINERAL PRODUCTION OF

Year	Gold, value	Silver, value	Copper		Mineral paint (ochre)		Clay	
			Pounds	Value	Tons	Value	Tons	Value
1922	$1,413,465	$11,648	[2]				[2]	
1923	1,205,784	7,316	1,598,776	$235,020			[2]	
1924	853,961	7,463	4,724,441	618,902			[2]	
1925	652,433	8,324	4,906,650	696,744			[2]	
1926	576,889	6,229	5,240,927	733,730			[2]	
1927	219,217	3,982	750,909	98,367			[2]	
1928	162,372	1,469	150,911	21,731			[2]	
1929	103,843	3,444	1,200,494	211,287			[2]	
1930	112,913	1,555	1,857,248	241,442				
1931	152,771	989	184	17				
1932	186,378	763						
1933	442,980	1,927	2,248	144			[2]	
1934	1,274,862	7,021	144	11			[2]	
Totals	$58,191,331	$1,489,352	112,047,115	$18,439,060	[2]1,876	$13,958	[2]6,956	$11,061

[2] Under 'Unapportioned.'

CALAVERAS COUNTY, 1880-1934—Continued

Mineral water		Miscellaneous stone	Quartz crystals, value	Miscellaneous and unapportioned		
Gallons	Value	Value		Amount	Value	Substance
1,914	$639	$35,590	[2]	22 fine oz.	$2,150	Platinum.
				----------	39,391	Clay (pottery), copper, gems.
1,626	569	39,825	[2]	----------	9,605	Clay (pottery), quartz crystals, lead, platinum.
1,400	139	83,250	----------	----------	8,704	Clay (pottery), gems (quartz crystals), lead, platinum, silica (quartz), soapstone.
[2]	----------	78,506	[2]	----------	14,611	Clay (pottery), gems (quartz crystals), lead, mineral water, platinum.
	----------	59,000	[2]	----------	433,924	Cement, clay (pottery), gems (quartz crystals), lead, mineral water, soapstone.
[2]	----------	[2]	[2]	222 tons	5,063	Chromite.
				4,606 lbs.	290	Lead.
				----------	1,281,795	Cement, clay (pottery), gems (quartz crystals), soapstone, miscellaneous stone.
[2]	----------	557,020	[2]	2,817 lbs.	163	Lead.
					2,059,787	Cement, quartz crystals, mineral water, platinum, soapstone.
[2]	----------	360,982	[2]	8,227 lbs.	521	Lead.
					1,896,182	Cement, clay, quartz crystals, mineral water.
[2]	----------	818,507	[2]	1,297 lbs.	65	Lead.
					909,474	Cement, quartz crystals, mineral water.
[2]	----------	185,810	[2]	4,386 lbs.	162	Lead.
					753,805	Cement, quartz crystals, mineral water, platinum
[2]	----------	49,254	[2]	642 lbs.	19	Lead.
					498,785	Cement, pottery clay, quartz crystals, mineral water, copper.
[2]	----------	46,436	----------	6,363 lbs.	253	Lead.
					447,259	'Unapportioned.'
[2]	----------	48,339	----------	612 lbs.	23	Lead.
					866,436	Cement, pottery clay, mineral water.
[2]123,310	$50,320	$2,390,569	[2]$65,500	----------	$9,565,791	

Atlas Imperial diesel locomotive which is used as an auxiliary haulage unit. Two 18-ton capacity cars are used to a train. The quarry benches are worked to a height of 50 ft., Drilling is done with a 6-inch 50 B-E well drill, driven by a 15-h.p., 440-volt, 1200-r.p.m. induction motor. The holes are drilled 18 ft. apart along the quarry face and about 35 ft. between rows to a depth of 5 ft. below the floor of the bench. From 30 to 50 holes are drilled in a row and blasted together. From 80,000 to 120,000 tons of rock is shot down at a time. Two power shovels, mounted on caterpillar tractors, load the broken rock on the cars. A Bucyrus-Erie 2-cu. yd. shovel is used at the quarry which is 2800 ft. distant from crusher, while a Bucyrus-Erie 2½-cu. yd. shovel and a 1¼-cu. yd. gasoline-electric Marion shovel are operated at the nearer quarry.

Automobile truck haulage from a third quarry was commenced in December, 1935. The 6-mile road built to this new quarry at Old Gulch, east of plant, is of railroad grade, suitable for electric haulage, the maximum grade with a load being under 1%.

The 18-ton cars from the quarries are run onto the tipple above a 42-inch gyratory crusher and dumped by compressed air. From this primary crusher the 6-inch rock is lifted up a 15° incline by a 36-inch belt conveyor 206 ft. between centers to a 10-inch gyratory crusher. The belt discharge passes over a 4½ by 7 ft. grizzly set on a slope of 40° and having 1¾-inch openings, the fines from which are sent through a chute to the rock storage. The oversize is fed to the secondary crusher, set at 1¾-inch opening, and the resulting product is discharged to a separate pile in the rock storage. Almost all of the shale, which is fed along with the limestone to the primary crusher, will fall through the grizzly. The grizzly actually acts as a classifier in separating the shale from the rock. The rock storage capacity is 25,000 tons, divided into three compartments, one for shale, the center bay for low-lime rock, and the other for high-lime rock.

A Milwaukee crane, equipped with a 3-cu. yd. bucket, transfers the raw material to and from the piles within the storage area. From the raw material bins the rock is fed to two 2-compartment Allis Chalmers compeb wet-grinding mills. They are 8 and 7 by 26 ft. and are driven by two 500-h.p. Allis Chalmers motors. From 91 to 92% of the slurry is ground to 200-mesh, and has a moisture content of 34%. Each mill grinds an average of 22.6 to 24.8 tons per hour. Two electrically controlled air-operated Allis Chalmers slurry pumps carry the slurry from the raw mills to 8 slurry tanks, which are inter-connected below so that any two tanks may be intermittently blended to obtain a uniform mix. About 75% pure limestone with 25% shale or clay is used to obtain a mix. Another set of two slurry pumps carry the slurry to two correction tanks. From here the slurry is fed to either one of two 4-inch Wilfley slime pumps which elevate the slurry to two Ferris-wheel feeders. These feed the slurry to two Allis Chalmers 11 ft. 3 inch by 10 ft. by 240 ft. rotary kilns, fired by Dubbs residual fuel oil (6½° to 7° B.), having a fuel value of 18,050 B. T. U. per pound (8.33 pounds per gallon).

The clinker discharge from one kiln goes to a 74-ft. Lee cooler, recently installed. The other kiln discharges clinker to an Allis Chalmers rotary cooler, 8 by 71 ft. The coolers discharge, by gravity, to clinker storage piles. Another Milwaukee crane equipped with a

3-cu. yd. bucket transfers the clinker from storage to the finish mill ore bins. At the finish mill, gypsum is fed to a separate bin between the two clinker bins and is fed along with the clinker to two Allis Chalmers 8x26 ft. compeb mills, driven by two 650-h.p. Allis Chalmers motors. The finished cement, ground to 92% to 93%, 200-mesh, is carried by two 6-inch Fuller Kinyon pumps to 10 silos where it is distributed to the different bins. The total capacity of the 10 silos is 140,000 barrels. From the silo bins the cement is delivered by cross-conveyor screws to a bucket elevator, which in turn feeds through a conveyor screw to two 3-spout Bates valve packing machines, which handle approximately 425 barrels an hour. The cement is delivered from the packing machines to a belt which carries the 94-pound bags ($\frac{1}{4}$ of a barrel) to the Mexican packers, who truck the sacks to railroad cars.

Four different types of cement are made, consisting of Calaveras Regular, Plastic Early Hardening, Calaveras White, and a Low Heat Cement. Approximately 400,000 barrels of the latter were used in the construction of the San Francisco-Oakland Bay Bridge. The total plant capacity is reported as 1,200,000 barrels a year. The total connected power load for plant and quarries is 5100 h.p. During the past two years the plant has been operated on 6-hour shifts, but the men have been paid on the regular 8-hour basis. About 85 men are employed.

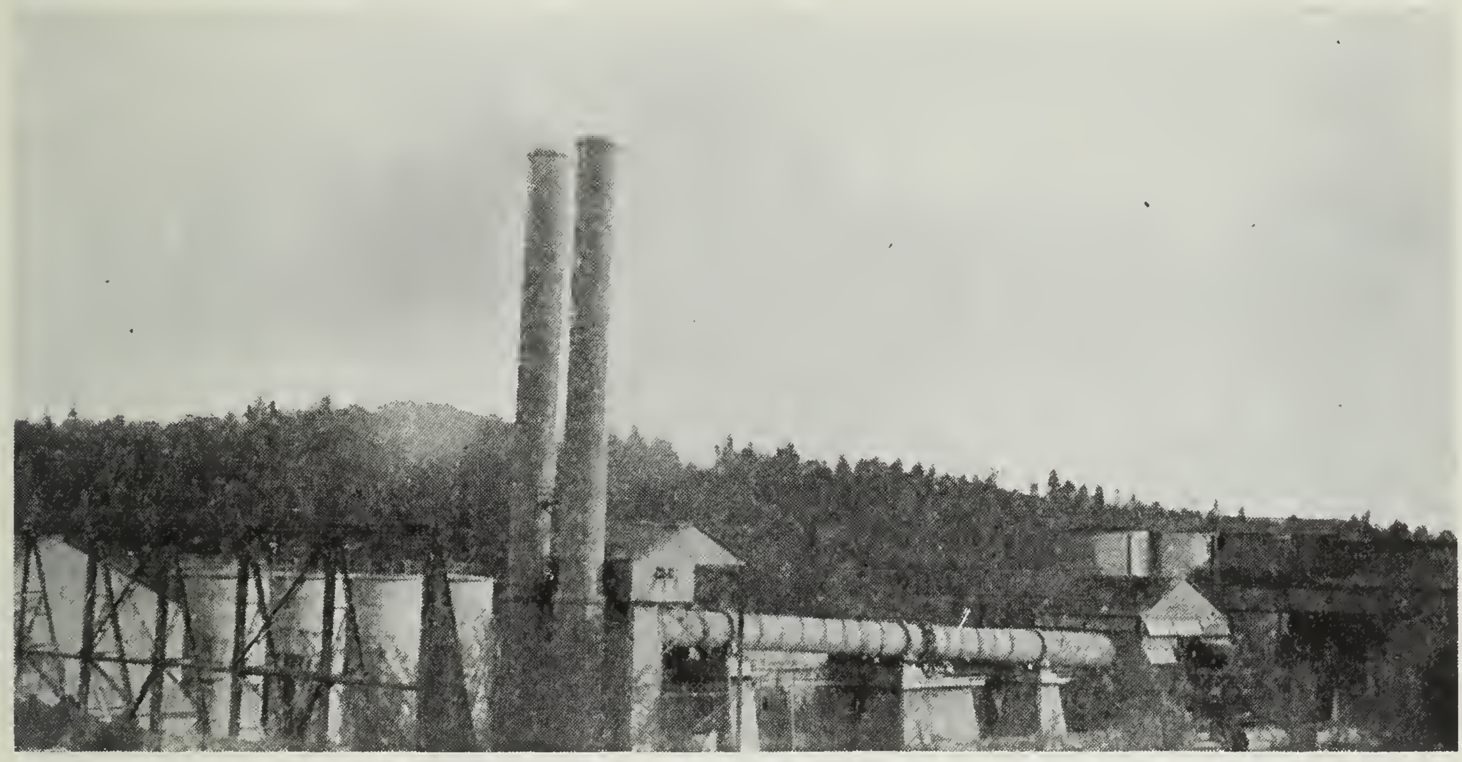

FIG. 1. Plant of Calaveras Cement Company.

Bibl.: State Mineralogist's Report XXI, pp. 165 and 167. U. S. Bur. of Mines, Inform. Circ. 6610. U. S. Geol. Surv., Jackson folio.

CHROMITE

The *Dean, Hinch, Burnham,* and *Wilson* chromite claims have been relocated by J. H. Bowie, Copperopolis. Some recent development work has been done on these claims, all of which except the Hinch, are located in Secs. 8 and 9, T. 1 N., R. 13 E. The Hinch property is in the SW¼ of Sec. 3, T. 2 N., R. 12 E. The *McFaul* property is also said to be controlled by Mr. Bowie. All properties are now idle.

Bibl.: State Mineralogist's Report XXI, p. 165. Cal. State Min. Bur. Bull. 76, pp. 121–123, 216–217.

CLAY

Valley Spring Clay Pit in Sec. 13, T. 4 N., R. 10 E., ¼ mile northwest of Valley Spring station, is worked and owned by the *California Pottery Company, Inc.,* of Niles, Cal. From 200 to 300 tons of this variegated, red-burning pottery clay is dug and trucked to Niles during a short period each summer and fall. It is used as a strengthening clay in roofing tile. This company also owns two shale pits near Valley Spring. The shale is used for experimental work.

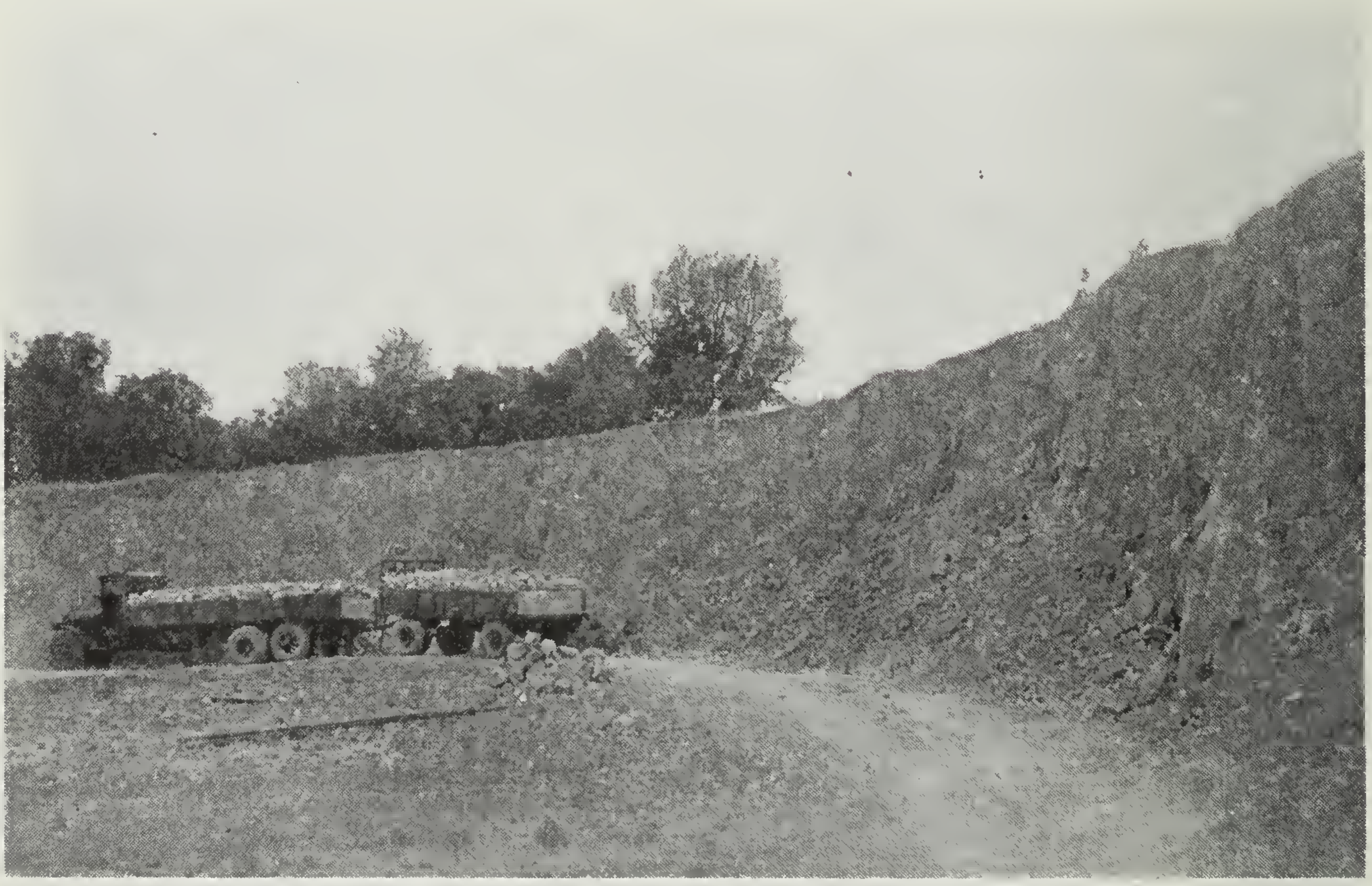

FIG. 2. Truck loaded with clay at Valley Spring Clay Pit.

Bibl.: State Mineralogist's Report XXI, p. 167.

MINERAL WATER

Gianelli Crystal Spring, at Douglas Flat, is owned by Mrs. Mary Roberts, Douglas Flat. A Sterling electric pump is used to pump the mineral water to the surface from the shallow depth. The water is put into 5-gallon bottles and trucked to the Crystal Distilled Water Company, 1906 Pacific Avenue, Stockton, where it is sold for drinking water.

Mok-Hill Mineral Springs. L. Walkmeister, Sutter Creek, owns a small bottling plant at Mokelumne Hill which utilizes water from a nearby spring, 12 ft. deep. The spring water is piped to the plant, where it is carbonated and bottled in syphons and ⅕-gallon bottles. This mineral water has been used since the early days. It is marketed as 'Mother Lode Mineral Water.' About 50 gallons are produced daily. Two men are employed.

STONE

Angels Greenstone Property, or *Tryon Mine,* is operated by the *Pacific Minerals Company, Ltd. (formerly Angels Greenstone Company, Pacific Rock Granule Company),* with office address at 337 10th Street, Richmond. Charles S. Renwick, Jr., is president; T. H. De Lap, secretary; C. M. Devore, mine and plant superintendent. The mine, situated on the southeast side of Angels Camp, is owned by Charles W. Tryon, Angels Camp.

The green amphibolite schist, locally called greenstone, is mined from the 200-ft. level and hoisted up the vertical shaft to the surface grinding plant. The rock is crushed by two large jaw crushers, passed through two sets of rolls, and then over a series of screens for grading. The dust is removed by air suction. The ground material is stored in a bin, and is sold for roofing granules. A concrete mixer is used to color roofing granules when desired.

Bibl.: State Mineralogist's Report XXI, pp. 168–169.

SOAPSTONE

Commercial Mineral and Mining Company, San Francisco, worked a soapstone deposit for a few months in 1925 on the John Peirano Ranch, 2 miles north of Carson Hill. Todd Elliott shipped the soapstone. Property is now idle and all equipment has been removed.

Bibl.: State Mineralogist's Report XXI, p. 171.

Soapstone is said to occur in Secs. 1, 2, 3, 10, and 11, T. 3 N., R. 13 E., about 3 miles west of Murphys, on property belonging to Chas. P. Snyder, San Andreas.

GOLD QUARTZ MINES

Summary of Geology.

Mother Lode Belt.

The quartz mines of the Mother Lode in this and adjoining counties have been fully described in Bulletin 108 of this division, 1934, by C. A. Logan, to which reference should be made for further details.

This lode, from which the larger part of the gold produced in the county has come, crosses the south county-line at Robinsons Ferry (Melones) on Stanislaus River and is easily traceable because of its massive quartz outcrops as far as Angels Camp. The two most productive sections of the lode have been within the townsite of Angels Camp, and the group of mines extending from Stanislaus River to the north slope of Carson Hill. The former group is in profoundly altered and silicified amphibolite schist. The Melones and Carson Hill groups, extending a mile and a half north from the river, had their best ores in or near altered intrusives occupying contact areas between the amphibolite schist and the Calaveras formation. However, much of the low-grade 'schist ore' similar to that at Angels Camp has been milled at the Melones Mine and is now being treated by Carson Hill Gold Mining Corporation, which has consolidated the former Melones and Carson Hill holdings.

Numerous small mines and prospects have been worked in the amphibolite schist west and northwest of Angels Camp. Characteristic of this section are 'stringer leads' of quartz and calcite with occasional pockets, found over a width of two miles in the schist. Going north from Altaville, however, no very important orebodies have been found for several miles. The Gwin Mine, opened many years ago in the Mariposa slates near the north county-line, produced several million dollars from ore similar to that mined in this slate in Amador County.

Mokelumne Hill district, often spoken of as being on the Mother Lode, is east of the main lode, at the southeast end of a batholith of granodiorite, and its numerous quartz mines are in this rock or in its contact zone with the Calaveras (Carboniferous) formations through which the batholith forced its way. This camp was also one of the most famous early-day placer-mining sections of the state.

East Belt.

This term has been applied to all of the quartz-mining districts lying east of the main Mother Lode in the counties from Mariposa northward to Placer. In Calaveras County, most of the East Belt mines, with the exception of those of the West Point district, are in the rocks of the Calaveras (Carboniferous) formation, a 'catch-all' classification of a series of tightly compressed and steeply tilted siliceous slate, mica-schist, and quartzite with numerous lenses of limestone and interbedded, contemporaneous dikes. The veins of the east belt are generally narrower, and the ores are richer and carry a greater variety of sulphides, yielding richer concentrate than on the Mother Lode. Sheep Ranch Mine has been the most important so far found on the east belt in this county. Unit costs of operation are also higher, and treatment problems more complex than on the main lode. The history of some of these districts is summarized below.

Glencoe and Railroad Flat Districts.

Glencoe is 10 miles northeast of Mokelumne Hill by good road, and Railroad Flat lies about four miles farther east, both districts being at elevations of 2000 to 2500 ft. in a large area of Calaveras (Carboniferous) rocks in which mica and chlorite schists and black slate are most prominent. Veins of gold-bearing quartz are numerous and at one time, previous to 1885, many small properties were worked and produced ore of good grade. They have all been lying idle for many years. In most cases there is no definite record of the results of operations and many of the present owners who are non-residents of the districts know little about the extent of workings and size or grade of ore shoots. A few figures from sources believed reliable are given herein.

Quartz mining began in these districts in the 1850's and the Mosquito Mine had a 15-stamp mill in 1857. A custom-mill was built at Railroad Flat in 1866. The Petticoat Mine was discovered in the course of hydraulic mining. This exposed the outcrop at a point where the ore proved very rich, yielding nearly $100 a ton, according to an old report. This mine was worked at intervals until 1912 and the main shaft reached a vertical depth of 650 ft. but produced little, if any, gold after 1899 when $67,000 output was reported. The Poorman Mine with a shaft 312 ft. deep, produced good ore before 1883.

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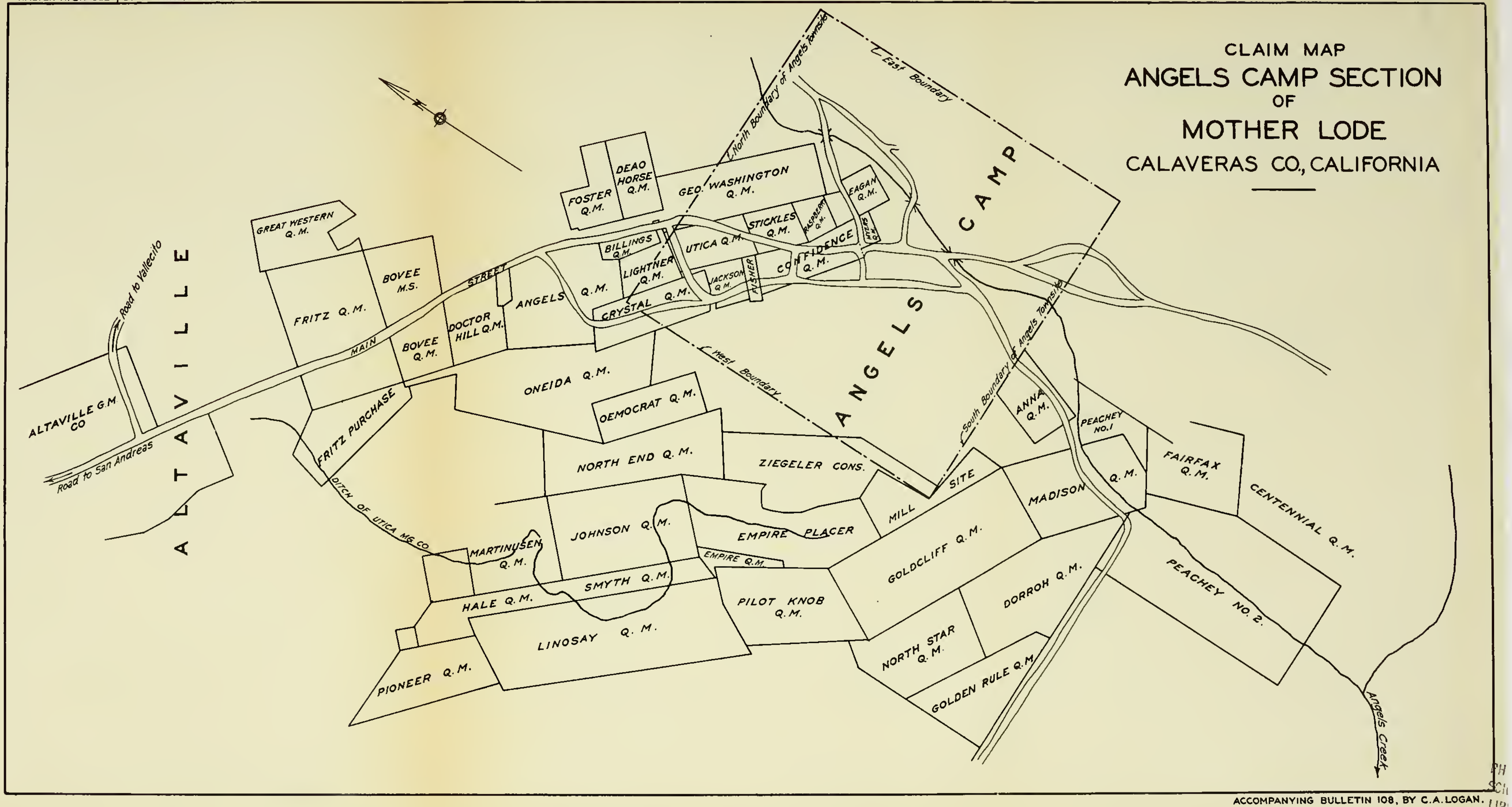

CLAIM MAP
ANGELS CAMP SECTION OF MOTHER LODE
CALAVERAS CO., CALIFORNIA

N
Road to Vallecito
ALTAVILLE
ALTAVILLE G.M. CO
Road to San Andreas
GREAT WESTERN Q.M.
FRITZ Q.M.
BOVEE M.S.
BOVEE Q.M.
MAIN STREET
DOCTOR HILL Q.M.
FRITZ PURCHASE
DITCH OF UTICA M.G. CO.
FOSTER Q.M.
DEAO HORSE Q.M.
GEO. WASHINGTON Q.M.
BILLINGS Q.M.
LIGHTNER Q.M.
ANGELS Q.M.
CRYSTAL Q.M.
UTICA Q.M.
JACKSON Q.M.
FISHER
STICKLES Q.M.
RASPBERRY Q.M.
EAGAN Q.M.
MYERS Q.M.
CONFIDENCE Q.M.
North Boundary of Angels Townsite
East Boundary
West Boundary
South Boundary of Angels Townsite
ANGELS CAMP
ONEIDA Q.M.
DEMOCRAT Q.M.
NORTH END Q.M.
ZIEGELER CONS.
MILL SITE
ANNA Q.M.
PEACHEY NO. 1
Q.M.
FAIRFAX Q.M.
CENTENNIAL Q.M.
MADISON
JOHNSON Q.M.
EMPIRE PLACER
EMPIRE Q.M.
MARTINUSEN Q.M.
SMYTH Q.M.
HALE Q.M.
LINOSAY Q.M.
PIONEER Q.M.
PILOT KNOB Q.M.
GOLDCLIFF Q.M.
DORROH Q.M.
NORTH STAR Q.M.
GOLDEN RULE Q.M.
PEACHEY NO. 2.
Angels Creek

ACCOMPANYING BULLETIN 108, BY C.A. LOGAN.

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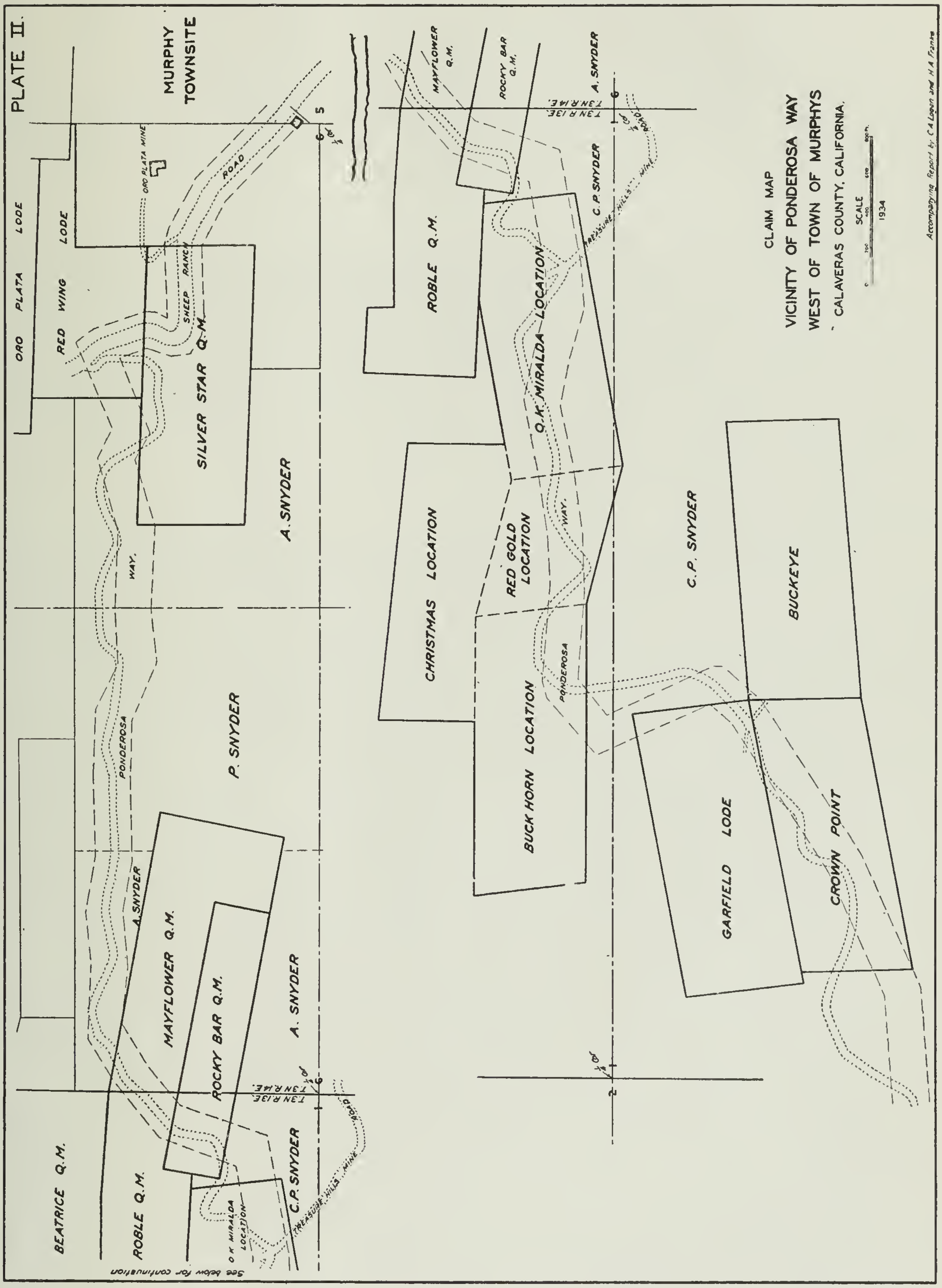
PLATE II.
CLAIM MAP
VICINITY OF PONDEROSA WAY
WEST OF TOWN OF MURPHYS
CALAVERAS COUNTY, CALIFORNIA.
SCALE
1934
Accompanying Report by C.A. Logan and H.A. Franke
MURPHY TOWNSITE
ORO PLATA LODE
RED WING LODE
ORO PLATA MINE
ROAD
SHEEP RANCH
SILVER STAR Q.M.
A. SNYDER
WAY.
PONDEROSA
P. SNYDER
A. SNYDER
MAYFLOWER Q.M.
ROCKY BAR Q.M.
A. SNYDER
T.3N.R.13E.
T.3N.R.14E.
BEATRICE Q.M.
ROBLE Q.M.
O.K. MIRALDA LOCATION
C.P. SNYDER
TREASURE HILLS MINE ROAD
See below for continuation
MAYFLOWER Q.M.
ROCKY BAR Q.M.
A. SNYDER
ROBLE Q.M.
C.P. SNYDER
TREASURE HILLS MINE ROAD
O.K. MIRALDA LOCATION
CHRISTMAS LOCATION
RED GOLD LOCATION
WAY.
PONDEROSA
BUCK HORN LOCATION
C.P. SNYDER
BUCKEYE
GARFIELD LODE
CROWN POINT

The Chapman or Seeman Mine had a shaft 250 ft. deep and an 8-stamp mill about the same time.

In the Glencoe district, the Valentine Mine had a 20-stamp mill and several nearby claims had been worked to depths of from 150 to 400 ft. early in the 1880's. The Norwich, Fidelity, Alabama and Charlotte had also yielded good ores. By 1884, most of them had reached the water-level where sulphide ores were found. Veins which had been yielding from $10 to $100 a ton (probably sorted ore in many cases) appear to have no longer offered promise to the operators, and most of them have lain idle until the recent increase in the price of gold.

Rich Gulch District.

This is six to seven miles east of Mokelumne Hill by good road, lying southwest of Glencoe in a region covered by Calaveras (Carboniferous) rocks. The principal quartz mines have been the Quartz Glen and Ilex. Little has been done in the district in late years. The rich gold placers of early days derived their gold from numerous small veins, most of which have been worked only in a desultory way by pocket hunters.

West Point District.

Perhaps no mining district in the state, of comparable area, has had as much prospecting work in the form of shallow shafts and adits as this section of northern Calaveras County, which may be reached by road from Glencoe or Railroad Flat on the south, or from Jackson and Pine Grove in Amador County. It has been said that a total of 500 shafts have been sunk, most of which went no deeper than 150 ft. which was about the limit of oxidized ore and 'picking ground.' Mexican miners did much of the earlier work, carrying ore out of the mines on their backs and using arrastres for crushing it. The camp was known from the early 1850's for its pocket mines, and claims were then limited to 200 ft. in length. In 1867, eleven small mills were in operation, mostly doing custom work for individuals or small groups of miners. The Woodhouse Mine had been the largest producer up to that time with a record of $140,000 free gold from 14,000 tons of ore. At later dates the Blazing Star (400 ft. deep), Champion (900 ft. deep) and Lone Star (778 ft. deep) were notable producers. In the period since 1920, the only new strike of any size in the district was the discovery of a shallow ore-shoot on the Columbus Mine near the Lone Star, where about 1800 tons of good ore was mined between 1921 and 1925.

Most of the mines in the district lie in the area of granodiorite which has a width of nearly five miles from north to south and extends west nearly five miles from West Point in the form of a peninsula from the main batholith of the Sierra Nevada. The granodiorite penetrated the older metamorphic rocks which were for the most part originally sedimentary but have been compressed and tilted and altered to black micaceous schists, hard slate and quartzite. Though little studied, these are supposed to be of Carboniferous age. These formations, which are the country rocks of the East Belt mines farther north and south, have here for the most part been swept away from the surface of the granitic rock. The latter shows local variations along its borders. Two series of greenish diorite dikes occur in it. Jointing is common in the granodiorite.

The veins generally have strikes between north and N. 25° W., and dip west or southwest from 45° to 80°. Some of them persist on the strike for as much as a mile or more. Intersecting joints probably offered favorable conditions for ore deposition where they met these main veins. The resulting ore shoots at such intersections were frequently only 25 to 50 ft. long. Some ore shoots in the more important mines ranged from 100 to 450 ft. long. Of the dikes, those which accompany the veins are about contemporaneous with them. Those occupying cross fissures are probably later and quite often appear to have not faulted the ore, although it is stated that a dike cut off the ore in the Champion Mine, which has been closed and inaccessible for many years. There is little evidence of post-mineral faulting and generally little evidence of mineralization of the adjacent wall rocks, except in the case of the large Loan Star vein, which has a width of 17 ft. near the shaft, and occupies a crushed zone. The average width of many of the smaller veins is hardly over one foot, and many of them are frozen to the walls.

Below the oxidized zone, good ore is typically greasy-looking, bluish quartz. Pyrite, pyrrhotite, galena, zincblende, marcasite, arsenopyrite and chalcopyrite occur and the amount of sulphides sometimes exceeds 20%. The iron sulphides are by far the most common. In value, concentrate ranges from $50 to several hundred dollars a ton.

Mines west of the Mother Lode.

Going west from Angels Camp, alternating beds of amphibolite schist, Mariposa and Calaveras slates may be seen until near Milton and Jenny Lind the unaltered ancient shore-line deposits of the Ione formation are reached. Quartz mines have been found in all these members of the bedrock series. The geology of these mines is sufficiently covered in the descriptions that follow, herein. They carry ores usually of low grade, predominantly in the amphibolite schist. Royal Mine, one of several at and near Hodson, has been the largest development in this section. The mineralization is sporadic in this region, and development and production to date have not been extensive nor sustained.

Angels Deep Mine, formerly *Brown-Smyth-Ryland Consolidated*, consisting of *Pioneer*, *Martinusen*, *Pat*, *Johnson*, *Hale*, *Demarest* and *Smyth* claims, is located about 1 mile south of Angels Camp; Pope S. Austin, Chicago, Ill., owner. It is being prospected by Earl Hyde, P. O. Box 23, Altaville. Mr. Hyde commenced operations from the Benson Pioneer shaft April 19, 1935, but had worked the property through the Smyth shaft two years previously. Both shafts were reconditioned.

The Benson shaft (also called Pioneer and Angels Deep) is 500 ft. deep, at an incline of 78°. Levels are: No. 1, 50 ft.; No. 2, 135 ft.; No. 5, 423 ft. Development on these levels includes 50 ft. of work on No. 1; 800 ft. on No. 2; and 800 ft. of old work and 500 ft. of new development on No. 5 level. The 140 ft. vertical Smyth shaft has No. 1 level at 84 ft., and No. 2 at 130 ft. No. 1 level has 400 ft. of old crosscuts, and No. 2 level has about 500 ft. of old crosscutting and 600 ft. of new development. There are other early-day workings on the properties.

This exploratory work on the Smyth ground by the present operator includes a 200-ft. drift northwesterly from the Smyth shaft on No. 2 level, and a 120-ft. drift southeasterly on a vein. From the end of this 120-ft. drift a crosscut was run 90 ft. southwesterly cutting a 6-ft. vein carrying $9 to $11 ore. Another crosscut from the end of the 120-ft. drift was run northeasterly for 154 ft., encountering a vein 22 ft. wide. A crosscut to the so-called Smyth vein on the northeastern side of the property showed vein material practically barren. A westerly crosscut on southwestern side of Smyth property extended through Benson Raise No. 1.

The vein formations strike N. 60° E, and dip 75° easterly. The ore is mainly quartz and chloritic schist. Both walls are schist. The three principal parallel veins in the upper Smyth workings have not been found extending to the lower levels. Apparently these veins have been cut off by a step fault. The present operators have not yet determined the amount of displacement, and were disappointed in the exploration work. The step fault strikes parallel to the veins, where exposed on the east end of the recent crosscut from No. 5 level, Smyth ground dipping about 23° E. The fault exposure up a 200-ft. raise from this level dips about 40° E.

A Sterling electric pump on Benson No. 2 level and two 600-gallon skips are used to unwater both the Smyth and Benson workings from the Benson shaft. The mine makes about 500 gallons of water per minute. Other equipment includes double-drum air hoist and a 1000-cu. ft. Ingersoll-Rand air compressor. A 20-stamp mill which was erected on the property in 1921 was sold in 1929 and removed to the Osborn property. Nine men were employed for two shifts, including six underground.

Since the above was written, it is understood that operations were discontinued early in 1936.

Annapolis, or Wilson Mine. This new prospect, opened up in the summer of 1934, is situated on the Carlton Ranch, 1¼ miles northwest of West Point. I. S. Harper and A. R. Burns of Missouri had a bond and lease on the property from A. R. Wilson, West Point, the owner. The prospect is said to have been abandoned shortly after the writer's visit in November, 1935. At that time it was developed by a 100-ft. inclined shaft, from the bottom of which a drift had been run 80 ft. north and 80 ft. south. The quartz vein, from 6 to 52 inches wide, strikes north and dips 45° to the west. Both walls are granodiorite. A gasoline engine driven hoist was used and a 25-ton mill was being installed. The new installation was to include a Cyclone ball mill, amalgamation plate, Tetrault table concentrator, and a compressor. Three men were employed.

Banner Mine, situated in the former town of Glencoe, is owned by J. S. Wright, Berkeley. E. R. Rice and H. B. Anthony have bonded and leased the property and have unwatered the old workings. The vein strikes north and dips almost vertically. Another vein, striking east, is said to intersect it about 200 ft. north of shaft. The ore is base and free milling. The footwall is mica schist and the hanging wall is granodiorite. The old inclined shaft is 200 ft. deep, with levels at 80, 140, and 200 ft. The shaft commences at a 70° angle, but is almost flat at the bottom. Old workings include a 112-ft. drift northward and a short drift southward on 80-level; drift 157-ft. northward and a short drift southward on 140-level; and about 150-ft. of drifting northward on the 200-level. A small amount of ore has been taken from the vein on the 200-level, which is from 8 to 12 inches in width. Equipment includes an electric centrifugal pump, Chicago Pneumatic air compressor driven by 15-h.p. motor, generator driven by a 6-cylinder gasoline engine, blower, and a single-drum hoist driven by a 4-cylinder gasoline angine. A total of 7 men are employed two shifts a day in the present development program.

Banner Mine, formerly *North Star,* in Sec. 23, T. 5 N., R. 13 E., 5 miles northeast of Mountain Ranch, is owned by James Madonna, Mountain Ranch. It includes 12.5 acres of patented land, with mineral rights to the adjoining 40 acres. The 10-ft. vein strikes northwest and dips east. Development includes a 45-ft. vertical shaft, with a 25-ft. drift on the vein. Idle for many years.

Bibl.: Calaveras County Reg. of Mines, p. 12.

Belmont Osborn Gold Mining Company has taken over the property formerly known as the *Osborn Prospect, Osborn Consolidated Mine,* 3½ miles west of Angels Camp. The present company plans to include operation of the Morning Star Mine near Hodson with its Osborn mine, the new company to be known as the *California-Osborn Mining Company.* The new operating management is controlled by the *California-Engels Mining Company,* which in turn is owned and operated by the *California Copper Corporation.* Office address is 333 Montgomery Street, San Francisco. Cyril Stevenson is president and general manager and S. T. Galbraith is secretary-treasurer. W. I. Nelson is mine superintendent.

The Osborn property, consisting of 9.81 acres, was operated by the *Belmont Osborn Mining Co.* in 1929 and 1930. They put down a new inclined (73°) shaft, which was 150 ft. deep in January, 1930. Mine operations were discontinued later on in 1930, and only a small amount of work was done on the property at intervals from 1931 to 1934. Operations commenced again early in 1935, and were taken over by the present management on July 5, 1935.

The Osborn mine is on the western mineralized zone of the amphibolite schist of the Mother Lode. There are quartz outcroppings on the slope north of the main shaft indicating four veins striking N. 42° to 55° W., dipping about 75° NE. Development includes the new inclined shaft, which has reached a depth of 350 ft. On the north side of the property there is an old 101-ft. inclined shaft, 330 ft. from the new shaft; and on the south side there is an old 164-ft. inclined shaft. A drift from the old 101-ft. shaft toward the new one, started in 1929, was never completed. The new shaft has levels at 70, 150 and 350 ft. From the 150-ft. level of this shaft there is a 160-ft. drift running southeastward. On this drift, 50 ft. from the shaft, a crosscut was run northeast for about 75 ft. into the hanging wall. This crosscut is said to have exposed four veins, ranging from 4 to 12 ft. in width. The first vein, averaging 5 ft. in width, was stoped the length of the 75-ft. northward drift. Ore was also mined and milled on a 60-ft. drift from a 65-ft. winze sunk from this 75-ft. drift. This ore is said to average from $10 to $14 a ton. The vein material consists of calcite, amphibolite schist, and quartz. This vein strikes northwestward and dips 67° eastward. The footwall is amphibolite schist and the hanging wall is black slate.

The present operators have driven a 140-ft crosscut eastward to the vein on the 350-ft. level, from which point they have drifted 100 ft. northwest and 120 ft. southeast. A drift 90 ft. north and another 200 ft. south have been driven from a point 25 ft. east of the shaft off of the same 140-ft crosscut. The 200-ft southward drift has an 80-ft. crosscut to the east and 100 ft. to the southwest. A little development work has also been completed eastward on the 150-ft. level.

Only 10 of the 15 stamps on the property were ever used. They were last operated from December, 1934, to March, 1935. The other milling equipment included a rock crusher, amalgamation plates, four old 6-ft. Belt type concentrating tables, a clean-up barrel, and a 75-h.p. motor. Other machinery included a 380-cu. ft. Rix compressor; electric hoist, driven by a 30-h.p. Westinghouse motor; and a 20-h.p. Ingersoll pump.

The present operators have removed five of the old stamps and are installing a 200-ton, 8-ft. by 36-inch Hardinge mill, to be operated in closed circuit with a Model D, 6-ft. by 21-inch, Dorr classifier. It is also planned to install a Clark-Todd amalgamator, 6 Kraut flotation cells, Dorr thickener, and an Oliver filter. The remaining 10 stamps will not be used.

The Gold Hill Mine, comprising 4.82 acres south of the Osborn mine, was taken over in the spring of 1936. The 330-ft. shaft had been retimbered and work of unwatering the property was in progress in May, 1936. There are said to be about 3000 ft. of old drifts in this mine. There are levels at 165 and 300 ft. The *Osborn Truax Claim*, 11.66 acres; the *Osborn Placer* mine, 32.3 acres; and the *Clark* quartz mine, 3.43 acres; have also been taken over by the company. An average of 25 men are employed on these properties.

Bence Mine, consisting of one unpatented claim near Esmeralda, is owned by Mrs. Minnie Hengen, San Andreas. Al. W. Paulson of San Francisco worked the property for a short time about 1934. He milled some ore, but found the water supply inadequate. Joe E. King, Sonora, sampled the mine recently and has obtained a lease on the property. The vein varies from 20 inches to 6 ft. in width, and the ore is said to average about $10 a ton in free gold. The ore also contains sulphides. Another 10 ft. vein on surface has not been developed. Workings include a 90-ft. crosscut to vein, from which the vein has been drifted on for a distance of 400 ft. There is an 86-ft. raise to the surface. The 5-stamp mill on the property includes a jaw crusher, Card concentrating table, and a 35-h.p. Doak gasoline engine.

Best and Belcher Mining Company, 333 Kearny Street, San Francisco, has taken an option on the 320-acre John F. *Scieffard Ranch* and the adjoining *Everlasting Mine*, about ½ mile south of San Andreas. H. L. Slosson is president and M. Grotyohn is secretary of the company. W. H. Clary is superintending operations on the new one-compartment prospect shaft, situated about 1000 ft. north of the old caved 150-ft. Everlasting shaft. This operation commenced November 15, 1935. At a depth of 65 ft., this shaft had disclosed a 12-to-14-ft. quartz vein, which has been drifted on for 45 ft. The ore is said to assay from $3.50 to $16 a ton. Equipment includes an electric hoist, portable Rix compressor, and a Worthington pump. Three men are employed.

This company also has an option on the *Commodore,* or *Golden Gate Mine,* 1 mile north of San Andreas, which is owned by W. H. Clary, San Andreas. The Commodore or East vein, is reported to be a mineralized quartz diorite intrusive. The hanging wall is talc schist and the footwall is greenstone and serpentine. The present shaft was sunk in 1899. A mill-test of 100 tons from the old workings was made in May, 1900, at the Ford mill, which is said to have averaged about $4 a ton. There was no further activity until July, 1933, when Best and Belcher Mining Company reopened the mine. Work was interrupted by fire in October, but resumed and early in 1934 the 200-ft. level was prospected by a crosscut to the west in an endeavor to strike the main Mother Lode vein. Operations ceased in September, 1934, before this vein was reached, and the property has been idle since.

Development includes a 300-ft. shaft, the first 80 ft. vertical, and the remainder on a 75° incline in the footwall. A 7-ft vein was crosscut in the 12-ft. eastward drift on the 80-ft. level. On the 200-ft. level, an 8-ft. crosscut eastward was driven another 8 ft. through vein material. A 10-ft. eastward crosscut to the vein on the 300-ft. level was followed by a 250-ft. drift north on the vein, which is said to be from 12 to 25 ft. in width on this level, assaying about $7 a ton. An electric hoist and power line remain on this property.

Big Horn Mine, about 3 miles north of Murphys, is owned by Alma L. Francis, 702 Couch Bldg., Portland, Oregon. Old workings include two tunnels on the vein, upper 400 ft. long, and lower 420 ft. long. A 50-ft. winze on the vein in the lower tunnel gives a total depth of 175 ft. from surface. Idle.

Big Seven Mine is 3 miles east of Copperopolis. W. G. Pettibone, Copperopolis, has an option and lease from P. Y. Lewis, Copperopolis, owner. There is a mineralized zone about 300 ft. wide, consisting of altered calcite, quartz, barite, and sericite schist. It strikes northwestward and dips east. Only 24% of the gold is free, the remainder being associated with galena, pyrite, and zincblende. The property has a 110-ft. inclined shaft, with levels at 50 and 100 ft. On the 50-ft. level there is a 30-ft. crosscut westward, and from the 110-ft. level a 75-ft. drift southward. An 80-ft. adit has been driven southward into the hill from the surface. Equipment includes a gasoline-engine driven jack pump and an old cement mixer, which was used to crush ore, with the aid of steel balls. The mine has not been worked to any great extent for over 20 years. A small piece of ore, said to be from underground workings, consisting mainly of quartz and barite, ran $12 a ton in gold.

Black Bart Mine, in Sec. 29 or 30, T. 2 N., R. 13 E., near Black Mountain, about 6 miles northeast of Copperopolis, is worked by the owner, Herman Cordes, Copperopolis. The property was formerly known as the J. Grossman Ranch. The mineralized vein material of quartz and slate, said to average a foot in width, strikes northwest and dips east. Present development, which was commenced in the winter of 1934, includes a 150-ft. adit driven southeastward, and a 30-ft winze. Equipment consists of hand tools, water pump and an 8-ton Ellis ball-mill driven by gasoline engine, amalgamation plate, and a sluice lined with riffles. Two men are employed in prospecting.

Black Wonder Mine is 9.2 miles east of West Point, on a ridge northeast of the Licking Fork of Mokelumne River. The vein strikes N. 18° E. and dips 70° W. It averages 2 ft. in width, with a maximum width of 5 ft. The XVIII Report of the State Mineralogist states that a shipment of ore from the shaft in 1919 was reported to carry 42% iron sulphides, 9% galena, 2% zincblende, with no copper or antimony. It returned 3 ounces gold and 17 ounces silver a ton.

The *Texacala Mining Company,* in which Edward Bateman of Fort Worth, Texas, was interested, operated the mine from the spring of 1932 until the summer of 1933. This company is said to have deepened the 130-ft. shaft to more than 200 ft. and continued some of the former workings. A ball mill, flotation cells and a diesel plant were erected, but this equipment has since been removed.

Blizzard Mine, 3 miles south of West Point, is owned by Jack Bardsley, West Point, and E. R. Shields, Bakersfield. *Blizzard Mining Company,* 1525 Noe Street, San Francisco, leased the property in November, 1933, and actively operated the mine from March, 1935, until October, 1935. A. Berwick was president; and Elmer H. Clark, vice president of the company, was living on the property when visited. Plans to reorganize the company had not been acted on early in 1936.

Most of the work was done on a 2-ft. vein striking eastward, but there are also two northwest striking fissure veins that traverse the property. The eastward vein dips north, and the latter two dip west. The northwestward veins are also said to average 2 ft. in width. The wall rock is amphibolite schist, with small seams of calcite. The vein material consists of quartz and some calcite, with a talc gouge. The ore contains pyrite, galena, chalcopyrite, and some free gold, and is said to have assayed about $4.00 a ton. A 27-ft. crosscut was driven north from the bottom of the 157-ft. inclined shaft to intersect the east vein, which was drifted on for a distance of 300 ft. westward. An old 180-ft inclined shaft, to the west of present shaft, is now caved in. The mine made about 15 gallons of water per minute. There is no mill on the property. Equipment includes Ingersoll-Rand compressor, jack pump, and single-drum hoist, all driven by gasoline engines.

It is understood that operations were resumed on this property in the spring of 1936.

Bonanza Mine, about 4½ miles northeast of Copperopolis, is owned by Adolph B. and G. Reusser, Copperopolis. The quartz and diabase vein material is from 1 to 3 ft. in width, striking northeast and dipping east. The ore contains free gold and sulphides. The footwall is talcose and the hanging wall is slate. Workings include a 95-ft. shaft, with levels at 30, 50 and 85 ft. Approximately 30 ft. of drifting has been done on each level, northeastward. The mine was last prospected in 1934, but the last shipment of ore was sent to the former Hamby custom mill in Angels Camp about 10 years ago. Equipment includes a gasoline-engine driven hoist, and a 3-stamp (850 pounds) Economy mill which has never been operated.

Bon Ton Mine is 5 miles north of Murphys, on ridge between San Antonio and Indian creeks. George S. Taylor sold this property belonging to the C. A. Whitney Estate of San Francisco to the *Bon Ton Mining Company,* 1957 Santee Street, Los Angeles, in April, 1935. Officers of the company are: T. R. Knudsen, president; Chas. W. Way, vice president; and J. B. Weber, secretary. L. G. Andrews is mine superintendent. There are two quartz veins, averaging about 2 ft. in width; strike east. It is a base ore. The present company is said to be deepening the 125-ft. shaft and driving a 1200-ft. tunnel to contact the veins. There is an old 500-ft. drift on the vein. A mill has not been erected. Five men are employed.

Boston Mine, formerly *Esperanza* or *Boston Consolidated,* comprising the Esperanza, Royder Placer and Mammoth patented claims and 6 unpatented claims, is 2 miles northeast of Mokelumne Hill. It is owned by the *Boston-Mokelumne Mining Company,* c/o E. R. Solinsky, Hobart Building, San Francisco.

The mine was operated at intervals from 1920 to 1925 by the *Morning Star Mining Company.* It was then idle until July, 1933, when the property was leased with option to purchase to R. T. Mishler and operated by the *Lucky Tiger Combination Gold Mining Company* of Kansas City, until July, 1935. They unwatered and sampled the entire mine, but it is said that assays on the 500 and 950 levels did not meet their expectations. Some development work was then done on the old 300 level and a new 200 level was driven. Most of the ore was mined from the 150 level to the surface, and no deep development was undertaken. The ore from the adit level (50 ft. deep) to surface was worked by means of a glory hole. In the meantime the mine was allowed to fill up with water to the 500 level. Milling operations lasted from December, 1933, until July, 1935. It is said that over $150,000 was produced during this period despite the fact that the ore was not selected and some gold was lost in milling. About 80 tons of ore were milled daily, running from $3 to $4 a ton. It is also said that the operators lost a considerable amount due to 'highgrading'. The operations are said to have closed down after the ground began to settle due to the mining methods used, after which the operators declined to go to the expense of reconditioning the mine workings. An injunction by the East Bay Utilities District to prevent the dumping of tailings in the Mokelumne River is also said to have influenced the mine's closing.

The vein strikes north and dips 30° to 40° east, with a maximum width of 50 feet. Development includes a 100-ft. inclined shaft, with levels at 50, 100, 200 300, 500, 700 and 950 ft. The ore contains free gold with pyrite and galena.

Milling equipment remaining on property consists of a Denver jaw crusher, a 6 by 8-ft, ball mill, 300-ton capacity Southwestern 5-cell flotation plant, Oliver filter and dewatering cone. Other machinery includes a two-drum electric hoist driven by a 125-h.p. motor and an Ingersoll Rand compressor.

Bright Star Mine, formerly *Black Cat,* is assessed to the *Aladdin Gold Mining Company, Ltd.,* a Nevada corporation, Holbrook Building, 58 Sutter Street, San Francisco; C. N. Miller, president; Mrs. E. N. Keller, secretary. This company acquired the property through a sheriff's sale, previous to which there had been some disagreement among the former company's officials and the superintendent. *The Bright Star Gold Mining Company,* of which Dr. E. W. Merrithew is president and T. W. Keller, vice president, still retains some interest in the property. John Conda, mine superintendent, commenced working this old mine in 1924, and spent much of his own money in its development. The mine was last worked about 1933, employing 6 men, although portions of the mine were retimbered and the mill remodeled in 1934. The mill was operated for short periods in 1927, 1928 and 1929 by the old company, with a total output of about $4,500. Mr. Conda hopes to obtain finances to resume operations in the near future.

This property is 6 miles northeast of Mokelumne Hill, on the southeast slope above Mokelumne River. There are eight unpatented claims, Bright Star, American, July Find, Gold Bulger, Joaquin, Hill Top and two others, in all comprising 120 acres. The principal, Bright Star quartz vein, 4 to 12 ft. wide, strikes northeast and generally dips south. There are said to be three other minor veins, averaging 4 ft. in width, which strike north and dip west. The footwall is porphyry and the hanging wall is said to be granodiorite on the upper level and slate in the lower workings. The ore contains pyrite, galena, and some free gold. Development consists of two crosscut tunnels driven southward to the vein, 175 ft. and 425 ft. respectively, called levels No. 1 and 2. There has been 550 ft. of drifting on the Bright Star vein on No. 1 level. On No. 2 level there is a 500-ft. drift westward and one 400 ft. eastward. Two raises have been driven from the lower, No. 2 level, through No. 1 to the surface. Another 175-ft. crosscut tunnel above No. 1 level has not reached the vein.

From the portal of the tunnel level the ore was trammed about 275 ft. to the mill. The mill contains a Risdon jaw crusher, Risdon Iron Works 10-stamp mill, and two amalgamation plates. Two Gibson concentrating tables will replace the two discarded Frue vanners. Water power, used to operate the mill, is furnished by a 5-ft. Knight water-wheel. Water is obtained from the Mokelumne ditch. The 150-cu. ft. Ingersoll-Sargent compressor is driven by a 5-ft. Pelton water-wheel.

Brown, or Defiance Mine, one mile north of Hodson, is owned by the Jackson D. McCarty Estate, Copperopolis. This old mine and 2-stamp mill was last worked from September to November, 1935. The flat vein formation is said to be 150 ft. across. Picked ore, mined by means of open cuts, is said to have milled $8 a ton. The country rock is amphibolite schist and slate.

Calaveras-Columbus Mine (formerly *Columbus*), comprising 80 acres, is located 3 miles northwest of West Point, on ridge southeast of the North Fork of Mokelumne River. O. C. Brink, L. M. Cox and Fred Buckner of San Francisco and Oakland have leased the mine from A. P. Dron, 2004 Yolo Avenue, Berkeley, owner. The present operations commenced February 5, 1935.

The quartz vein, 2 to 5 ft. wide, strikes north and dips 70° W. Both walls are granite. Some of the ore is of high grade, and consists mainly of pyrrhotite, with some copper sulphides. The mine is worked through a 500-ft crosscut, eastward, to the vein. There is a drift on this vein 400 ft. north and 400 ft. south. A 90-ft. winze has been sunk on the north drift. From the bottom of this winze there is a drift 50 ft. to the north and 150 ft. to the south, where the present development work is being done. The 80-ft. Gibson shaft to the main upper drift is not used. Ore is lifted up the 90-ft. winze by an air hoist, and then trammed down the drift and crosscut to a small mill on the bank of the river. The mill equipment includes a Gibson jaw crusher, Gibson rotary mill, amalgamation plate, and Deister concentrator No. 5. The mill was started by the present operators in November, 1935. A 20-h.p. Fairbanks-Morse semi-diesel engine operates the mill and a Gardner compressor. Four men are employed.

Cal-Gold Mining Company, incorporated in Nevada for $250,000, has obtained a lease and option on the *Parnell, Benson,* and *Hoffman* properties, comprising over 57 acres in Sec. 30, T. 3 N., R. 13 E., 3 miles northwest of Angels Camp. Officers of the company, whose address is Room 802, 381 Bush Street, San Francisco, are: Karl Bruchsaler, president and manager; Bryan Crossen, vice president; and E. M. Blake, secretary.

The properties adjoin the Belmont Osborn mine to the north, and the Osborn vein is said to pass through them. The Parnell vein apears to be approximately 65 ft. in width on the surface, but has been prospected only by pocket or 'high grade' hunters to a depth of 60 ft., mainly on the footwall side of the vein. The vein material consists of quartz, amphibolite schist, and slate. It strikes northwest and dips about 45° east. Eight feet of the footwall side of the vein is said to assay $15 a ton. However, the property had not been thoroughly sampled when visited in May, 1936. The footwall is slate. Eventually it is planned to mine the deposit by means of a power shovel. The erection of a building to house a 20-ton ball mill, amalgamation plate and an air compressor commenced May 14, 1936, employing four men.

The *Benson Mine,* worked by a company under the direction of John C. Benson from the latter 90's until 1909, is reputed to have been a good producer. Old workings are said to include a 510-ft. inclined shaft on vein, now caved, with levels at 100, 200, 300 and 500 ft. There is said to have been about 700 ft. of drifting on the vein, principally on the 100 and 200 levels. An old 10-stamp mill remains on the property.

Carson Hill Mines extensive holdings are located in T. 2 N., R. 13 and 14 E., on and about Carson Hill and to the Stanislaus River, about 4 miles south of Angels Camp. The principal mines and claims include the Melones, Morgan, Calaveras, Finnegan, Union, Kentucky, Iron Rock, Relief, Reserve, Enterprise, Santa Cruz, Calaveras, Irvine and McMillan. The properties are worked by the *Carson Hill Gold Mining Corporation,* Sonora, in which company the *Anglo American Mining Corporation, Ltd.,* Mills Bldg., San Francisco, has a considerable interest. Charles H. Segerstrom is president; Lawrence Monteverde, vice president of the operating company; and John A. Burgess, manager.

Many of the mines and claims now being worked as a whole were at one time operated separately, and are described in detail by C. A. Logan in State Division of Mines Bulletin 108, "Mother Lode Gold Belt of California," and in the former reports and bulletins of the

State Mineralogist. Since the printing of Bulletin 108 in 1934, the following activities had resulted up to the time of visit, November, 1935.

The Morgan and Melones mines have been reopened to the 3000-ft. level where new orebodies have been exposed in the footwall area. Ore is now being mined from that depth to the surface. On the surface the footwall glory-hole is being worked. One 1-yd. power shovel is being operated on a schist orebody on the hanging wall side of the 'bull' vein, and one $\frac{3}{4}$-yd. shovel is being operated on the outcrop of the Calaveras vein. Ore from the Morgan glory-hole, loaded on $3\frac{1}{2}$-ton capacity trucks by the power shovel, is hauled about 200 yds. to an orepass, which drops it to the 1100 level adit. A 5-ton electric locomotive, capable of hauling a load of 100 tons, delivers the ore to the mill by way of the 1100-ft. haulage level. The power shovel operation on the Santa Cruz claim is described in Bulletin 108.

There has been 14,000 ft. of development work done since the mine was reopened in 1933 from between the surface and the 3000-ft. level. Up to October 31, 1935, there had been 464,679 tons of ore milled since the mill was started in September, 1933. The maximum tonnage milled in any one month was 25,772 tons, in August, 1935. Up to that time the normal tonnage was about 20,000 tons per month. The tonnage milled is gradually being increased. The source of ore milled is as follows: 20% of ore hoisted, 20% of ore from Calaveras shovel, and 60% of ore from Morgan mine dropped to the 1100-ft. haulage level.

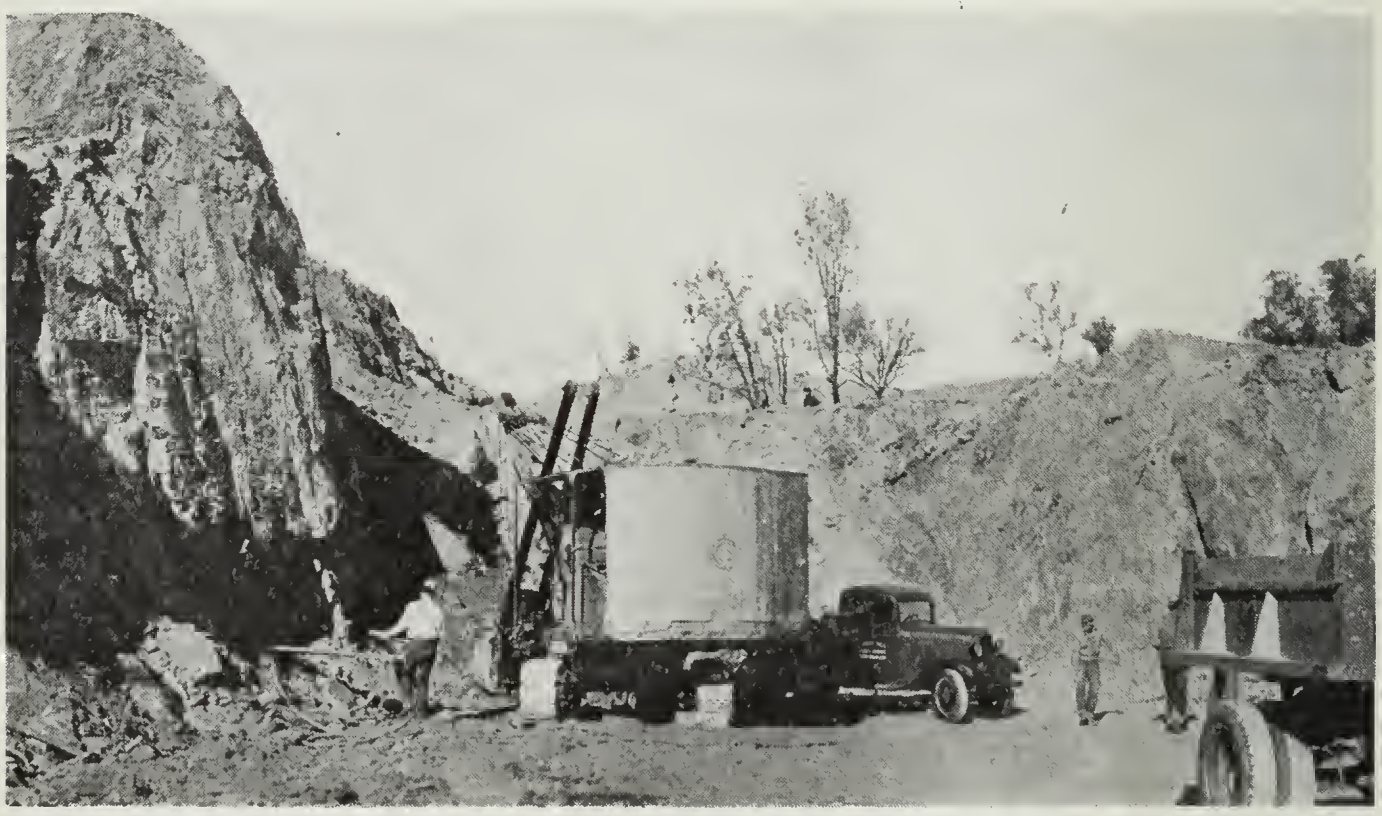

FIG. 3. Mining ore by means of power shovel on Santa Cruz claim of Carson Hill Gold Mining Corporation.

The latest flowsheet of the stamp mill and cyanide plant appears in the March, 1935 issue of Engineering & Mining Journal, pages 111 to 114. Since that article was written a gyratory crusher was installed to reduce the size of the ore fed to the 30-stamp mill. The crushed material goes through $\frac{1}{2}$-inch screens and to the three Hardinge mills.

Chaparral and Blue Ribbon Claims are located $10\frac{1}{2}$ miles east of San Andreas, on San Antonio Creek, and are owned by Charles H.

Cuneo, Esmeralda. A blanket quartz vein, 4 ft. wide, striking east, contains free gold and pyrite. Devolopment includes a glory hole, and a 300-ft. tunnel driven northward, that has not yet reached the vein. Two 100-ft. tunnels and shallow shafts comprise development on the Blue Ribbon claim. Mr. Cuneo, who prospects the claims at intervals, mills the ore in a concrete arrastre, 12 ft. in diameter. The arrastre is driven by an old style 8-ft. Pelton water-wheel. The arrastre makes 16 turns per minute, and is capable of milling a ton of ore in 24 hours.

Charlie Hoss Prospect, near Glencoe schoolhouse, is being worked by A. J. Bayless. Workings consist of a 22-ft. shaft and 180 ft. of drifting. Some 'high grade' pockets are said to have been mined several years ago.

Collier, or Blood Mine, 5 miles east of Murphys, is owned by Mrs. E. Mayers, San Francisco and Perry E. Condit, Murphys. The quartz vein strikes east and dips 80° N. The ore is very base in character, containing pyrite, galena, zincblende, arsenopyrite, antimony and tellurides of gold and silver. The country rock is a hard siliceous slate. Old workings include six tunnels, 225, 160, 275, 190, 400, 412 and 300 ft. in length. The property yielded a few tons of ore in 1925 and 1926.

Colorado Claim, located 2 miles southwest of the Mar John Mine, is owned by Frank and Charles Pescia, Sheep Ranch. It was last prospected about 1933. Development includes a 100-ft. inclined shaft, with a 40-ft drift easterly along vein on the 100-ft. level. The quartz vein is said to be from 6 inches to 1½ ft. wide. Country rock is slate.

Columbus Mine, formerly *St. Gothard* (patented), in Sec. 20, T. 5 N., R. 13 E., 4 miles northwest of Mountain Ranch, is owned by James Madonna, Mountain Ranch. The vein, 4 ft. wide, strikes east and dips north. It has a slate hanging wall and footwall. The mine was last worked several years ago. Development includes two shallow shafts.

Bibl.: Calaveras County Reg. of Mines, p. 16.

Cooper and Hercules Mines are separate, adjoining properties, centered about the Mayflower vein, which strikes east and dips to the north. They are 5 miles north of Murphys, on ridge between Indian and San Antonio creeks. The Mayflower quartz vein is about 8 ft. wide, and is intersected by the Mystery and Horseshoe veins, which average 2 ft. in width. The two latter veins strike northeastward. The ore is free milling.

Cooper mine, comprising 40 acres of patented land, and the adjoining unpatented mining claims, are owned by John Shaw, Murphys, and Frank Cooper, Douglas Flat, respectively. Frank Cooper and Nelse Jones have driven an adit 300 ft. toward the Horseshoe vein. They later plan to develop the Mayflower vein. There are a considerable number of old workings on the Hercules property, including a 100-ft. shaft on the Mayflower vein, 300 ft. of stoping on the Mystery vein, and a 160-ft. shaft on the Horseshoe vein. Equipment includes a 200-cu. ft. compressor, driven by a gasoline engine.

Hercules mine is owned by Eugene G. Staples, Sheep Ranch. The old workings include a 200-ft. shaft, with a 120-ft. drift north on 100-ft. level, and a 150-ft. drift north on the 200-ft. level. This shaft is now said to be caved. Another shaft on the Horseshoe vein is open for 50 ft., connecting with a 150-ft. adit. Idle.

Crown Point, Buckeye, and *Garfield Properties,* formerly known as *Old Mexican* and *Black McGann Mines,* 2 miles west of Murphys, are owned by M. H. Manuel, Murphys. There are a series of blanket veins striking northwest and dipping 18° NE. There has been no extensive development on any of these three patented properties, but rich pockets were taken out many years ago. These pockets occur on the contact of the vein with a porphyry dike. Old workings include a 225-ft. tunnel. Charles Williams and Albert Leonard, Murphys, have leased a portion of this property. They have a 12-ft drift from the bottom of an old 65-ft. shaft from which they have recovered a little high-grade gold ore. Hand tools are used.

Demarest Mine is on Cherokee Creek, about six miles south of San Andreas on an agricultural patent. The early development of this property is given in Bulletin 108. A. C. Tillman, Jr., Suisun, obtained an option on the property from Charles H. Segerstrom, Sonora, and commenced unwatering the mine on August 5, 1935. John Benson, Jr., is mine superintendent.

According to Bulletin 108, there are three veins within a width of 350 ft., but all work has been on the middle vein which lies at the contact of a strip of Mariposa slate about 150 ft. wide on the west, and one of the Calaveras formation some 200 ft. wide on the east. The middle vein is said to be 6 to 10 ft. in width on the 600-ft. level. Development includes a 690-ft. inclined (60°) shaft in the footwall slates, with levels at 100, 300, 400 and 600 ft. The 300-ft. level was cleaned out, but this work was temporarily discontinued in January, 1936, when the heavy rains prevented the development of the mine. The ore on the 300 level is said to average $6 a ton. It is planned to mine three parallel oreshoots about 200 ft. south on the 600-ft. level as soon as this portion of the mine is unwatered. These oreshoots had previously been stoped out about 40 ft. high, 225 ft. in length. A skip and pump are used to unwater the mine, which makes 22,000 gallons per 24 hours.

The 10-stamp mill was run intermittently by the present operator from September to December, 1935, on material obtained in cleaning up, when it was closed down because of the heavy rains. The mill also includes a rock breaker, two amalgamation plates, and four Frue vanners. There is an electric single-drum hoist and a 10 by 12 inch air compressor. Seven men are employed for one shift daily.

Doodlebug No. 1, 2, and 3 Claims, comprising 60 acres of unpatented claims in Sec. 22, T. 5 N., R. 12 E., 12 miles by road southeast of Mokelumne Hill near Whiskey Slide, were located by Ed King in June, 1935. Ed King and W. T. Treat, San Andreas, owners, leased the property to Cartte Wood and W. T. Stettenbenz, 46 Chestnut Avenue, Long Beach, in April, 1936.

The principal quartz vein strikes N. 80° E. and dips 70° NW. The gold in the ore is practically all free, with only a very small amount of sulphides. The footwall is slate and the hanging wall is granite. Development includes four adit tunnels, one above the other. The lower, No. 1 tunnel, is 300 ft. long; No. 2, 125 ft.; No. 3, 350 ft.; and the upper, No. 4 tunnel, 200 ft. No. 3 and No. 4 tunnels have a 90- and 45-ft. raise, respectively, to the surface. The first 7 tons of ore developed from a vein 7 ft. in width encountered in the crosscut tunnel on No. 3 claim by Ed King is said to have netted $265.

The 2-stamp mill on the property is being replaced by the new operators with a 35-ton ball mill, amalgamation plate, and two concentrating tables. A diesel engine will run the mill. An Ingersoll-Rand air compressor and a pump are driven by gasoline engines. A total of five men are employed one shift daily.

Dragone Lode (*Arizona*) comprises 17.5 acres of patented land, located May 5, 1924, 1 mile west of Murphys, on San Domingo Creek. Pete Dragone, Angels Camp, owner, worked the property with six associates for about a year, ceasing development in November, 1934. This development work consists of a 436-ft. lower tunnel, connected to the upper 120-ft. tunnel by a 140-ft. raise. A 100-ft. drift has also been driven off of the raise, between the two tunnel levels. The quartz vein, 1 to 6 ft. wide, strikes S. 75° E., and dips east. It outcrops a distance of 1500 ft. The ore is partly base and free-milling, and is said to average $5 per ton in gold. Both walls are of slate. Apparently a porphyry dike near the quartz ledge has had some relation to the mineralization. Two cross veins, striking northeast, are also said to traverse the property. Now idle.

Dutchess Consolidated Mine, consisting of the Dutchess, Little Dutchess, Hoosier Dutchess, Grand Dutchess, and two millsites, is 5½ miles southeast of Vallecito, on the northwest slope of Stanislaus River. It is owned by Ross C. Richey et al., 117 Belmont Street, Long Beach. The quartz vein lies in granodiorite, striking northeast and dipping 75° N. It is from 3 to 11 ft. wide. The ore contains considerable pyrite and some free gold, and surface assays are said to run from $3 to $13 a ton. Old workings include lower, middle and upper tunnels, in 1800, 475 and 400 ft., respectively. The present owners had four men opening up the caved lower tunnel for six months during 1935 in order to sample the mine, but the job had not been completed in November, 1935. The property is said to have last been operated by Nellie Lilly in 1905. Remnants of the old 10-stamp mill remain on the ground.

Charles *Dutton* is said to have recovered a few thousand dollars from pockets on a quartz lead found in a 90-ft. inclined shaft. The property is about ¾-mile southeast of the former town of Glencoe.

Easyz Bird Mine is owned and operated by the *Lucky Joe Gold Mining Company,* Box 292, Jackson. The property comprises about 460 acres, 240 acres of which are patented, on the southeast slope of Mokelumne River. Officers of the company are: J. G. Donaldson, president; W. L. Desnoyers, secretary-treasurer; G. W. Schilling, general manager.

The various claims were located between the years 1898 and 1914. A part of the large production from the French Hill gold placers is said to have been taken from the upper portions of the property. The quartz properties were exploited by various mining companies from 1898 to 1907, but the first important operation did not commence until the *Outlook Mining Company* of Boston, Mass., took over the mine. Their operation was discontinued when the drift on the Easyz

Bird vein encountered the 'Beatty fault,' a fault that threw the vein approximately 50 ft. northward. A lessee named Beatty then leased the mine, solved the question of the lost vein, and is said thereby to have recovered about $30,000. However, he lost his lease through failure to pay the required royalties. Fred G. King obtained the mine in 1914, adding a number of adjoining claims to the property, before selling out to Max Muller and associates. The latter first operated under the name of the *International Investment Syndicate.* Considerable work was done and a 50-ton mill erected. They later incorporated the company as the *Pacific Gold Mining and Milling Company,* but were forced to close down shortly afterwards in 1919 due to economic conditions. The property lay idle until 1931, when Gordon Sheckler and two other parties took it over and operated for approximately two years. Their failure to make the enterprise pay is said to have been mainly due to the lack of capital and experience. The present operators commenced in December, 1933, and they have rehabilitated the mine equipment and changed the flowsheet of the mill. They state that the mine is now on a self-sustaining basis and that development work is being vigorously pushed. Most of the development has been on the eastern portion of the property. From 35,000 to 40,000 tons of ore had been treated by the present company up to January, 1936.

There are three east-west veins—the Easyz Bird, Blue Bird, and Humming Bird. The principal developed vein, the Easyz Bird, strikes N. 60° to 80° E., as shown by a long discontinuous outcropping, and dips N. 75° W. It is a fault-fissure vein. It is intersected by a series of veins striking north, said to be more than thirteen in number, which include the J. P. Morgan, Challenge and Fraction veins. The ore-shoots form at or near these vein crossings. The Easyz Bird vein is said to be from 15 to 25 ft. in width. All of the country rock is meta-diorite, excepting the extreme eastern end of the property, which is Calaveras slate. Sulphides in the ore carry 90% of the gold and ore is said to run from $4 to $6 a ton.

The mine is developed by a 303-ft. vertical, three-compartment shaft, with 100, 200, and 300 levels. These levels are actually only 83, 183, and 287 ft. from the surface, respectively. The 100 level is also known as the adit level. Crosscuts have been driven to the Easyz Bird vein from the shaft on each level. Drifts on the vein from the crosscut on 100 level are 950 ft. westward and 750 ft. eastward; from crosscut on 200 level, 670 ft. westward and 1020 ft. eastward, and on 300 level, 600 ft. westward and 1050 ft. eastward. Twenty-four stopes have been mined in whole or in part. The present operators have obtained most of their ore from 12 stopes in the eastern workings. At the present time ore is being mined from No. 6 stope, 320 ft. east of shaft on 100 level; Nos. 10 and 12 stopes, 625 ft. and 800 ft. east of shaft on 200 level; Nos. 10 and 12 stopes, 700 ft. and 850 ft. east of shaft on 300 level. Five of these twelve stopes are about 100 ft. long. The west drift on the 300 level is now being driven, and a winze will be sunk to the 400 level from this drift in the near future.

A 12- by 24-inch Universal jaw crusher and a No. 2 Telsmith gyratory crusher, situated at the collar of the shaft, below the 100-ton storage bin, are used to crush the ore. The crushed material that passes the 3 by 6 ft. Symons shaking screen, openings 11/16 of an inch square, is dumped down to the 150-ton mine pocket above the adit level. The ore is trammed from the adit level above 1000 ft. in $2\frac{1}{4}$-ton cars to the 100-ton capacity ore bin at the mill. The ore is fed by a small belt conveyor to a 4 by 5 ft. Hendy ball mill. The ball-mill discharge goes to a Dorr classifier and the coarse material is returned for regrinding, while the fines go to a 5-cell Fagergren flotation unit. From a settling cone, the concentrates go to a single-disc American filter. The tailings are impounded behind four earthen dams below the mill. Approximately 110 tons of ore are milled per 24-hour day. Concentrate production is said to be approximately 100 tons a month. Mine equipment includes a single-drum electric hoist, a 700-cu. ft. Ingersoll-Rand compressor, blacksmith shop, saw mill, powder house, etc.

A total of 55 men are employed for two shifts, 35 of whom are underground. The total operating cost of the mine is stated to have been $2.65 a ton in November, 1935. This figure includes a cost of $4.65 a foot for development and 45 cents a ton for stoping. The mill treatment is said to result in 92.5% recovery.

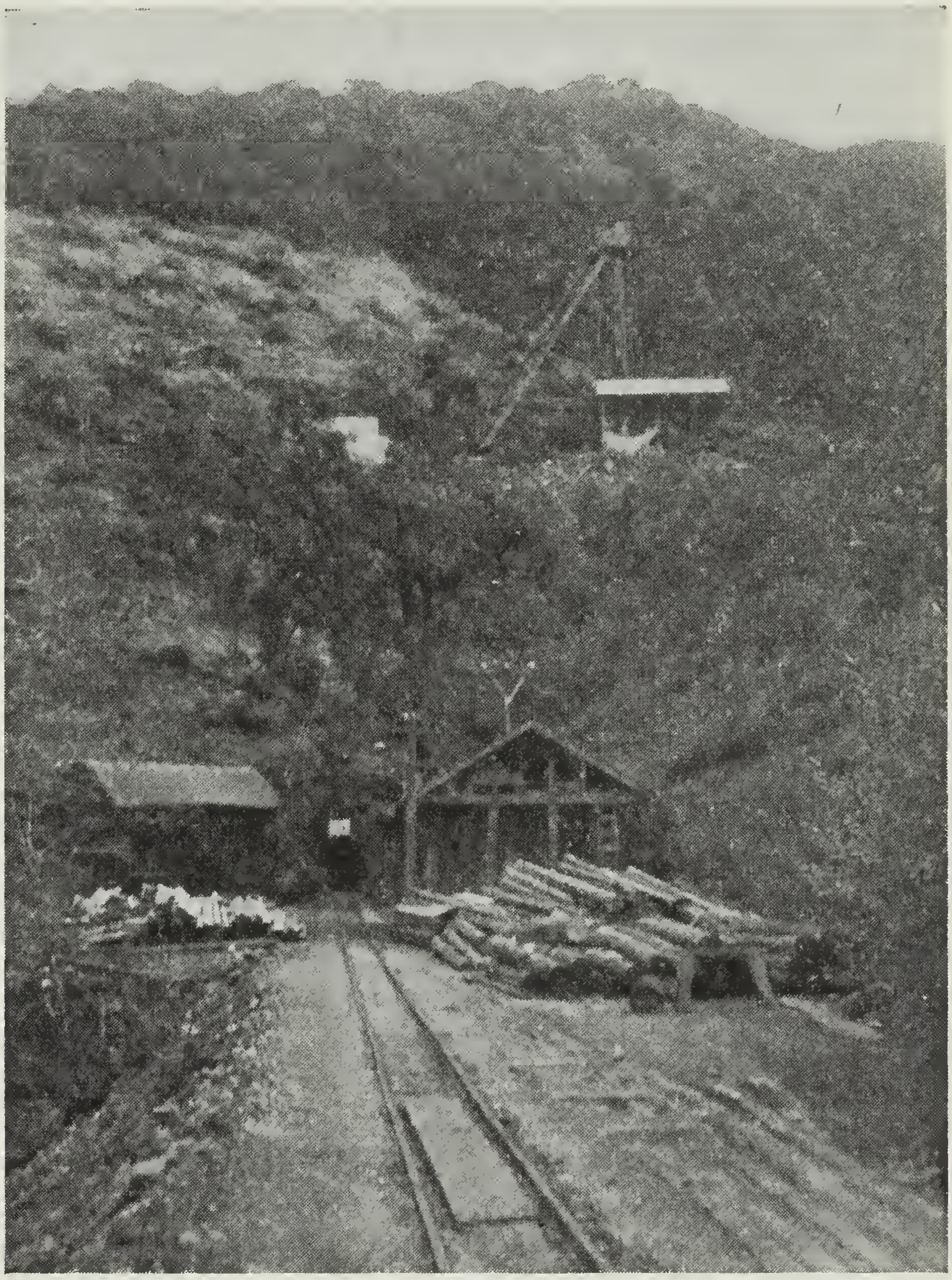

FIG. 4. Adit level of Easyz Bird Mine. Headframe and crushing plant above.

Empire Mine, which includes the Jumbo, Bryan and Empire claims, lies south of the Royal mine, about $3\frac{1}{2}$ miles northwest of Copperopolis. *Empire Mining Syndicate,* 324 A Mills Building, San Francisco, has an option and lease on the property from Frank S. Tower, Milton, owner. Alfred Meyers and Will Halloran are directing operations. This property, upon which initial operations commenced in May, 1935, was last worked in the 1880's.

The principal quartz fissure-vein, apparently in the footwall and parallel to the Royal vein, strikes N. 50° W. and dips 20° NE. Chloritic schist and diabase dike rock which accompany the quartz are in part mineralized, and both will be mined and milled. Seams of calcite run through the quartz. Numerous quartz stringers intersect the main vein. The main quartz and diabase vein material varies from 2 to 7 ft. in width. The ore contains pyrite, galena, sphalerite, and some free gold. It is said to assay about $5 to $8 a ton. There is a slate footwall and a diabase hanging wall.

The old workings, which have been cleaned out, include a 250-ft. inclined (18°) shaft, with levels at 25, 100 and 225 ft. On the 25-ft. level there is a 150-ft. drift north and a 50-ft. drift south. The vein has been opened up 300 ft. north and 200 ft. south on the 100-ft level. A 100-ft. adit crosscut intersects the south drift on this level. Another crosscut on the north drift is driven into the slate footwall for 100 ft., where a vertical raise connects to the drift on the 25-ft. level. On the 225-ft. level there is a 25-ft. drift on the vein on either side of the shaft. Another old inclined shaft which goes down to the 100-ft. level will not be used in the present operations.

A 100-ton ore bin has been erected. All of the ore will be trucked to the nearby Royal mill or to the Gold Knoll mill for treatment. The ore is to be hoisted from the incline shaft in mine cars by means of a Joshua-Hendy air hoist. Equipment includes a 300-cu. ft. Ingersoll-Rand compressor, to be driven by electric motor. No active development of the mine had commenced in the spring of 1936, and it is said that metallurgical tests were being made in order to establish the best method of extraction in treatment of the ore.

Fazzi, Jolly Tar, or *Mariposa Mine,* owned and operated by the *Angels Mining Company, Ltd.,* Morgan Bldg., Berkeley, is located just north of Altaville. Officers of the company include: R. J. Morgan, president; J. R. Beedle, secretary; and George R. Knoles, director. J. A. Fazzi, mine superintendent, discovered the property in 1921, and had worked it intermittently until the present development commenced in August, 1933.

There are said to be three veins on the property, the vein material consisting of stringers of quartz and calcite in amphibolite schist. Development includes a 300-ft. inclined (74°) shaft, with levels at 150 and 280 ft. No ore had been stoped when the property was visited in November, 1935. Work was then confined to retimbering the shaft and erecting a 10-stamp mill. A Plato concentrating table is to be added. Ore is to be transported to the mill by conveyor belt. Mr. Fazzi stated that a 1-ton skip was to be installed and the present air-hoist changed to an electric hoist. Other equipment includes a 314-cu. ft. Ingersoll-Rand compressor and an electrically driven Sterling pump. The mine makes about 90 gallons of water per minute. Eight men are employed.

Ferguson Mine, formerly *Cargo Hill,* is on the southern portion of the *Little Gulch* claim, and has been subleased to L. V. Floyd, Harry Case and Hibbard Moore, by Lawrence T. Baker of the Albatross Steel Furniture Company, Ltd., West Los Angeles. Carroll Evans and D. E. Hayes, 1144 Yale Street, Santa Monica, are the owners. It is 2½ miles east of West Point, apparently in Sec. 1, T. 6 N., R. 13 E.

The quartz vein, averaging about 8 inches in width, strikes north and dips 80° W. Diorite dikes cut the vein at places, and are thought to be responsible for the mineralization. The ore is base, and shipments to Selby smelter are said to average from $60 to $173 a ton. Both wall rocks are granodiorite. The vein quartz is of vitreous bluish-black character. The present operators, who commenced in June, 1935, have cleaned out and unwatered the old 165-ft. vertical shaft. Work is now confined to the 40-ft. northeast drift on the 90-ft. level. Equipment includes a hoist, compressor and a 30-inch Buffalo blower, all driven by gasoline engines. Three men are employed.

The King Solomon vein system is said to intersect the Little Gulch vein on the extreme southwestern corner of the Little Gulch claim. The *King Solomon* claim is also owned by Hayes and Evans. Its old workings include a 140-ft. shaft.

Fidelity Mine is 8 miles northeast of Mokelumne Hill, on Cedar Gulch. There is an 18-inch quartz ledge striking northwest and dipping east. The ore contains pyrite, free gold, and a little galena. The blue and white ribboned-quartz next to the wall rock is said to assay from $10 to $25 a ton. The foot and hanging walls are thought to be quartzite and slate, respectively. Old development includes a 75- and 200-ft. southward drift on the vein, and a 400-ft. northward drift. Present work is confined to the old northward drift, which has been opened up 210 ft. on the vein, which averages 3½ ft. in width. The old 165-ft. shaft has caved. The property has been worked since June, 1934, by Ed. Gilomen, R. F. D. No. 1, Mokelumne Hill, the owner. Mill equipment includes a jaw crusher, 15-ton Straub ball mill, amalgamation plate, and Straub concentrating table, all driven by a Star gasoline engine. Hand tools are used by the two persons now employed in cleaning out the old workings.

Fine Gold Mine is 4 miles east of Railroad Flat, on ridge southwest of the South Fork of Mokelumne River. The Fine Gold Mining Company, 431 Pacific Electric Bldg., Los Angeles, commenced operating the property in March, 1935. Horace Taylor is president, and Luke J. McNamee, secretary of the company; Francis Laidet, mine superintendent; B. A. Win, mill superintendent.

The Fine Gold Mine is said to have been discovered by John Gilman and first developed in 1886 by a 250-ft. shaft and three levels. In 1906 the property was worked by A. S. Merrill through the adjoining *Swiss mine*, closing down in 1910. The same operator had started to work the mine through the old Fine Gold shaft, but soon gave it up. In 1915 Oscar Huston and Francis Laidet opened a new shaft and turned the property over to Joseph Fassler, who operated until 1916. J. Green and Joseph Fassler took the mine in 1916, and leased it to Atkins and Kroll, San Francisco. The shaft was reopened and the mine sampled at this time, but no satisfactory purchase arrangement could be made and the mine was closed down until 1921. J. Green reopened the mine for a short time in 1921, but was forced to discontinue operations when sufficient capital was not obtainable to change the mill. A little work was done on the property by J. King in 1924. H. J. Quetin, Railroad Flat, present owner, leased the property to the *Western Pacific Gold Mining Co.* in 1934. The mill was not satisfactory and the present organization is erecting a new mill.

The quartz vein strikes north and dips 73° W. The vein varies from 6 inches to 2 ft. in width, and is said to average about $7 a ton.

The ore is base, containing graphite, pyrite, chalcopyrite, and arsenic. The footwall is Calaveras slate, and the hanging wall is called a diorite. When the property was visited in November, 1935, the old 250-ft. inclined (73°) shaft had been opened up to the 100-ft. level. The 200-ft. level had not yet been unwatered. There is a 600-ft. drift south on the 100-ft. level. Operations were just commencing on a stope 60 ft. long and 60 ft. high, in about 200 ft. from shaft.

A new 50-ton mill was being erected when visited. Milling equipment will include a 12-in. by 10-in. Blake-type jaw crusher; 6 x 14-ft. Colorado Iron Works ball-mill, to be worked in closed circuit with a 2 by 14-ft. Dorr classifier; surge tank and pump; 2-cell Groch rougher and cleaner flotation cells; 3-cell Fagergren flotation unit; 10-ft. Dorr-type thickener; 1 by 3-ft. Oliver continuous filter and a Deister No. 2 pilot table. The mill will be operated by electricity furnished by a 37½ K.V.A. generator, which is driven by a 50-h.p. Chicago Pneumatic semi-diesel engine. The ore will be delivered to a 35-ton surface ore-bin by ¾-ton skip and then trammed about 80 ft. to the 40-ton mill bunker. There is a gasoline-engine driven hoist and Ingersoll-Rand compressor. Ten men were employed in erecting the mill and four men were working at the mine. Since the above visit the mill has gone into operation and has been making substantial production for some time.

Foote & Thompson (Quartz Glen) Mine comprises patented quartz and placer claims in Secs. 26 and 35, T. 6 N., R. 12 E., six miles northeast of Mokelumne Hill on east side of Mokelumne River. Over a long period of years, these claims have been extensively prospected and a 10-stamp mill was operated irregularly up to 1913. The mine in 1872 was credited with a production of $200,000 in a two years' run with 10 stamps on ore taken out to a depth of 200 ft. The last 1000 tons which was milled gave an average yield of about $8 a ton. The workings consist principally of adits. The lowest, 75 ft. above the river, was run 324 ft. as a crosscut to reach the vein, which was followed about 400 ft. on the strike. All ore found here was stoped out and is said to have yielded from $3 to $27 gold per ton. Farther along the strike and higher on the slope, No. 2 and No. 3 adits were run. No. 2, still open, follows the vein 1563 ft. No ore was stoped. Assay values were reported ranging from 90 cents to $4 a ton (old gold price). No. 3 adit, 500 ft. above No. 2, is 1100 ft. long. It is partly caved, but said to show some good assay values.

The vein is reported to average 5 ft. wide, striking north and dipping about 70° W. It is in the region of the contact of a body of granodiorite with the surrounding Calaveras slates. Formerly a canal of 1200 miners-inches capacity supplied purchased water which was used for power under 700-ft. fall, to run a 5-drill compressor and the 10 stamps.

The old buildings include boarding- and lodging-houses, two dwellings, compressor building, shop, and assay office. The old stamp mill, three old concentrators, 2250 ft. of 8-in. to 12-in. pipe-line and compressor are also still on the claims. Nearly five acres of land formerly a part of the *Atwood Placer Mine,* was lately sold to *Aladdin Gold Mining Company.*

Ford Mine (also known as *Apex*) at San Andreas is being operated by James B. Ferguson, 355 Ocean Center Bldg., Long Beach. The mine is owned by Talton Hawes, 1760 Paige St., San Francisco, and the Ann. H. Dower Estate. Lester Deil is superintendent of present operations, which commenced about September, 1935, but which were discontinued at intervals. A small headframe was erected about 300 ft. south of the present main shaft, but the sinking of this new shaft has been temporarily abandoned.

There is an old 750-ft. inclined shaft sunk on the main vein, with levels at 100, 200, 300, 400 and 700 ft. The present operators have retimbered the old shaft to a depth of 300 ft. They are drifting on the main vein north of the shaft and are also working toward the East vein on the 300 level. There are said to be approximately 3,200 ft. of workings on the 300 level, principally south of the shaft. The old workings on the East or Hanging Wall vein and the West vein have not yet been entirely cleaned out. The country rock is amphibolite schist containing some layers of black slate.

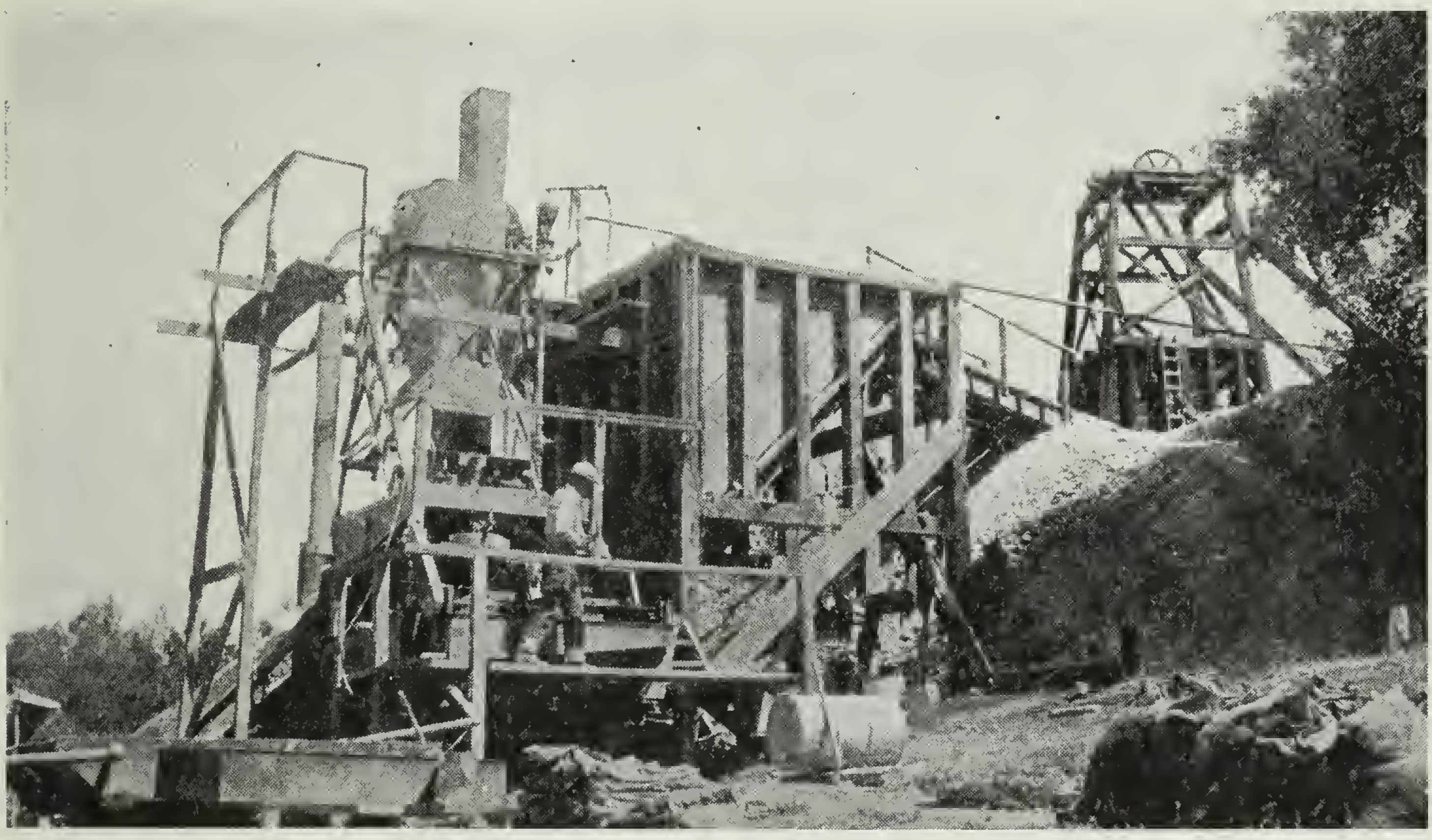

FIG. 5. Portable Hadsel impact-mill, with Pan-American jigger and two Kraut flotation cells, at Ford Mine.

A 35-ton capacity portable Hadsel impact-mill, with Pan-American jigger and two Kraut flotation cells, was installed on the property in the spring of 1936. This mill is treating about 30 tons of ore, one shift daily. The mill heads are said to run from $5 to $8 a ton. Plans are to erect a 120-ton ball mill in the near future. A new compressor and cable were recently installed. The mine is operated two shifts, and a total of 15 men are employed.

Forest Creek Mine, 4½ miles southeast of West Point, was prospected between 1923 and 1929 by the *Forest Creek Mining Company, Ltd.,* 5455 11th Avenue, Los Angeles. Development is said to include a 420-ft adit on a vein 6 to 24 inches wide, on the south slope of the Middle Fork of Mokelumne River. There is a 55-ft. winze, 225 ft.

from the portal of this adit, from which the vein was drifted on a distance of 100 ft. north and south. There is also the 37-ft. 'Chick' shaft. The vein strikes northeastward and dips almost vertically. The small tonnages of ore produced between 1924 and 1929 yielded from 0.1 oz. to 0.75 oz. gold per ton, nearly all in the sulphides. The property is idle, and no equipment remains thereon.

Emil Ritzman, listed in 1935 as president of the company, foreclosed a mortgage on all the property of the company except the mill and mining machinery in January, 1935.

Fricot Holdings (by D. J. Fricot, Angels Camp) include the following claims: *Columbus, Rochester, Fricot Consolidated Mines, Square Block, Idaho Consolidated Mines, Horseshoe, White Pine, Bonanza Placer, Bounty Placer,* and *Genial Joe* claims, about 2 miles north of Esmeralda, but none have been worked in recent years. There is a series of parallel veins, with an average width of 2 ft., which strike east and dip north. There is also a series of stringer veins striking north. The principal formation is mica schist. Old workings include shallow shafts and tunnels of various lengths.

The following claims, consisting of 82.77 acres, are also owned by Fricot: *Alhoa-Klondyke, Mammoth, Yaqui Camp, Seven Up Lodes,* and *Johnston Placer* claims.

Caruthers patented claim, also owned by Fricot, 4 miles north of Murphys, on ridge south of Indian Creek, has not been worked lately. Old workings include a 200-ft. tunnel which connects with the bottom of a 200-ft. shaft. The nearby *Florence* claim is held by the same owner.

Galena-Gold Hill Mine, formerly *Gold-Galena,* is 2 miles northeast of West Point, on ridge southeast of Skull Flat. It is owned and operated by the *Winsor Investment Company*, 6th and K Streets, Sacramento; Clarence Breuner, president; Lawrence Lorang, mine superintendent. The mine had been idle since about 1906, until the present operators commenced in June, 1935.

There are two veins, the Galena and the Gold Hill. The latter has not been recently developed. The Galena quartz vein strikes N. 16° W. and dips 80° W. The ore carries mainly galena and pyrite. Both walls are granodiorite. Development includes a 200-ft. shaft, which is vertical as far as the 100-ft. level, but dips with the vein to the 200-ft level. On the 100-ft. level, there is a 150-ft. drift northward on the vein, which averages 6 inches in width. On the 200-ft. level a 25-ft. drift had been run north and a 10-ft. drift south.

There is no mill on the property, and at the time of visit in November, 1935, some sacked ore was ready for shipment which was expected to net $200 a ton but actually yielded about $80 a ton. The average ore is said to run about $40 a ton. Mine equipment consists of a Fairbanks-Morse hoist, 300-cu. ft. Ingersoll-Rand compressor, air drill, sharpener, a Dow sinker pump and a gasoline engine. The mine makes about 20 gallons of water a minute, which has been troublesome. The mine was operated two shifts, employing a total of 10 men.

Late reports state that the mine was closed down in the spring of 1936.

Garland Ranch Mines, in Secs. 8 and 18, T. 3 N., R. 14 E., 2 miles south of Murphys, were taken over by Walter B. Lenhart, 1424 East Ocean Ave., Long Beach, Erick Borchgrevink, and C. E. Wright of Fresno, in 1935. This 357-acre ranch contains a quartz and gravel property.

There is a quartz vein, called the Shepherd vein, about 30 inches in width, which outcrops for about 200 ft. It strikes northeast and dips almost vertically. The ore is heavily mineralized with pyrite and some free gold, and is said to assay $8.50 a ton. This vein had been prospected only with open cuts, but plans were to sink a 200-ft. shaft on the vein, drift 400 ft., and then crosscut 200 ft. over to another mineralized zone called the Mary Jane. There is an 80-ft. adit and a 60-ft. raise to the surface on the Mary Jane. Ore from the face of the last workings in the Mary Jane tunnel is said to assay better than $8.50 a ton. Two men were prospecting when visited in November, 1935, but the writer has since been advised that all operations have been temporarily suspended.

Two ancient auriferous channels are also said to traverse the ranch. One of the channels, said to be ¾-mile long, had been prospceted in the last four years by sinking eleven churn-drill holes. These tests showed that there is a 180-ft. lava capping, under which there is from 18 to 35 ft. of gravel, which is gold-bearing near bedrock.

The other channel is said to have been worked several years ago by the *Butte Mining Company,* under the direction of Louis Stines. *The Keystone Development Company* and *Vallecito Coalition Company* were also said to have figured in this operation. A 60-ft. shaft was sunk through the andesite lava-capping to bedrock, and a 60-ft. drift driven along the channel in 6 ft. of gravel.

Garibaldi Mine, consisting of 38 acres of patented land, in the old town of Glencoe, on the ridge northeast of Cedar Gulch, is owned by T. P. Shufelton, San Francisco. Old workings include a 40- and 60-ft. prospect shaft. Idle.

German Ridge and Jupiter Mines are situated 5½ miles by road northeast of Angels Camp. Owner: *German Ridge and Jupiter Gold Mines Corp.,* 242 W. 42d Street, Los Angeles; John Christie, president, and John Gaarden, secretary-treasurer.

John Gaarden and Henry Wiley commenced development of the property in 1931 and 1932. The company began operations in 1933, and ran the mill from the spring of 1934 until August, 1934, all operations ceasing in December, 1934, because a lean streak of ore was encountered and the sale of stock was not sufficient to continue development. The ore occurred in rich pockets, and one piece of picture rock that was exhibited at the California State Fair, Sacramento, in 1933, took the first premium award. The owners state that from $14,000 to $16,000 was produced in 1933 and 1934.

The vein strikes N. 47° W., dipping 70° west, but the dip is said to steepen below the 100-ft. level. The footwall is slate and the hanging wall is porphyry. The gold-bearing ore occurs mainly in quartz next to the slate footwall, and carries some pyrite. The vein varies from 1 to 12 ft. in width. The property is developed by a 140-ft. shaft, with levels at 55 and 100 ft. The principal workings consist of a 150-ft. drift south and an 80-ft. drift north from the 55-ft. level; and ten feet of drifting north and south on the 100-ft. level.

There is a 20-h.p. Doak gasoline engine to operate a 5-stamp mill and a Nash gasoline-engine driven hoist on the property. Hand tools were used in the mine, which is now idle.

Gold Hill Mine, 3 miles south of Murphys, is owned by George S. Taylor, Murphys. The property was prospected by a Mr. Grebner and associates of Los Angeles several years ago. A Mr. Admanson and associate of Huntington Park are now working the claim. Workings include a 110-ft. shaft and three tunnels, 190, 500, and 400 ft. in length.

Gold Knoll Mine, on the Womble Ranch, is about ¾ mile northwest of the old *Wilbur Womble Mine*, near the old town of Hodson. The *Felix Mining Company,* 4492 Mission Street, San Francicso, formerly owned the property, comprising 520 acres. A partnership consisting of Chas. W. Rebmann, Fred Seitz, L. Cereghino, and Richard A. Ford, 479 Stevenson Street, San Francisco, now own the mine. It was operated at intervals for four years by the Felix Mining Company. Previously, from about 1925 to 1927, initial operations were pursued by the *Gold Knoll Mining Company*, under the direction of E. E. Schmitz of San Francisco. Alfred Meyers, 324-A Mills Building, San Francisco, obtained an option and lease on the mine in the spring of 1936, and is now employing nine men at the mine.

The principal, west quartz vein, in slate and schist, strikes northwest and dips 45° NE. The sulphide concentrates from this ore are reported to run $68.00 a ton. The east, Miller vein, is said to be 26 ft. in width on the 100-ft. level, but has not been extensively prospected because it is of too low-grade, averaging $1.25 a ton. The continuity or relationship between the west and east veins has not been worked out, and position of only the west vein is well established.

Development includes a 300-ft. inclined shaft, with an adit level, about 50 ft. deep, also 115- and 300-ft. levels. The east vein has been drifted on a distance of 50 ft. northwestward on the 115-ft level, from which point a crosscut has been driven west to intersect the west vein. The present operator has cleaned out the old workings on the 115-ft. level, and is stoping ore from several points on the west (footwall) vein. One stope is approximately 60 ft. in length and 20 ft. in width, with two openings to the surface. The vein varies in width from 6 to 20 ft., and in value from $1 to $8. This vein has been opened up a distance of about 400 ft. northwestward, and active prospecting is being conducted on the northwest extension of the vein. The principal workings on the 300-ft. level, now partly caved, consist of a 1000-ft. drift northwest of shaft, from which three crosscuts have been driven, each approximately 200 ft. in length. It is reported that an orebody on the west vein, 75 ft. in length, was worked on this drift, about 700 feet northwest of shaft. However, much of the workings on the 300-ft. level are said to be in slate footwall, and little ore ever found.

Milling equipment, electrically driven, includes 10 stamps, two amalgamation plates, two concentrating tables, two Frue vanners and a settling cone. There is an electric hoist, 500-cu. ft. Laidlaw-Dunn-

Gordon air compressor driven by a 75-h.p. motor, and a blacksmith shop. The present operator commenced operating the mill the latter part of April, 1936. The mine is now being worked one shift, and the mill is operated three shifts daily.

The adjoining *Wilbur Womble Mine,* worked many years ago, has also been leased by Alfred Meyers from the Felix Mining Company. This old mine was worked by a glory hole 200 ft. long, 50 ft. wide and 100 ft. deep, with a shaft reaching a depth of 185 ft., or 132 ft. vertically. The pay-shoot worked, 450 ft. long and 50 ft. wide, is said to have averaged $1.50 to $2 in free gold, and an equal amount in concentrates. The old 15-stamp Merrall mill has been largely dismantled, although nine of the stamps remain. There is also an old tailings dump, which has been sampled but not worked. Mr. Meyers, who has been prospecting the property, states that the mine appears to be suitable for a large surface operation. He estimates that an orebody is available from 50 to 150 ft. or more in width, averaging $2.50 to $3.50 a ton.

Gold Star Mine, formerly *Tolman Mine and Milling Co.,* 4½ miles east of West Point, is owned by R. F. Funston, West Point. George Marshall and R. S. Foster, West Point, have been working the mine for William De Witt, lessee. This one claim is said to be the first located in the vicinity, and dates back to 1858. Development includes a 145-ft. vertical shaft, with a level at 110 ft. On this level there is a 30-ft. drift southward on the vein, and a 70-ft. drift northward, from which some ore had recently been stoped. The 4-ft. quartz vein dips east. The ore is said to average $53.00 a ton, and contains galena, sulphides, and some free gold. Equipment includes a cylinder pump and single-drum hoist, driven by gasoline engine. Due to the lack of sufficient funds, development ceased at the mine in November, 1935, but the mine was kept unwatered.

Golden Fleece Claims, 3 mines southwest of West Point, were prospected by Vernon Striker and Ray Mason of Railroad Flat, from about 1932 to the summer of 1935. A 5-stamp and a 2-stamp mill which were placed on property have now been sold. Idle.

Gold King Mine is 8 miles east of Railroad Flat, on the Licking Fork of Mokelumne River. The mine was unwatered and sampled in the fall of 1935. Alfred Schrant of Long Beach and Miller Brothers of Los Angeles plan to commence operating the property in 1936. Old development includes a 214-ft. tunnel on the vein, and a 75-ft. winze. J. T. Jones, Railroad Flat, is the owner.

Golden Sherer Mine, a new prospect, in Sec. 35, T. 6 N., R. 13 E., 1½ miles south of Railroad Flat, is owned by A. P. Stotts, R. F. D. No. 1, Box 35, Mokelumne Hill. *The Golden Sherer Mining Corporation,* 326 S. Spring Street, Los Angeles, is operating this property, which adjoins the Sanderson mine. L. B. Sherer is president, and A. H. Winter, mine superintendent.

The quartz vein pinches and swells, but averages from 12 to 18 inches wide. It strikes northeast. Both walls are said to be schist. The ore contains sulphides and a little free gold. A shipment of ore to Selby smelter is said to have run $136 in base-ore values and $20 in free gold, or a total of $156 a ton. Development includes a 150-ft. inclined (45°) shaft, with levels at 100 and 130 ft. There is a 40-ft. and 100-ft. drift northeast on vein on the 100 and 130 ft. levels, respectively. The stope on 130-ft. level is 20 ft. wide and 10 ft. high. Plans are to deepen the shaft 30 ft. and commence another level. Equipment includes a Bull Dog gasoline-engine driven hoist, Rix compressor and a blacksmith shop. Three men were employed in building a track to dump the waste rock when visited in November, 1935.

Gopher Hill Mine, on Buckhorn Creek, nine miles southwest of Copperopolis, probably in Sec. 10, T 1 N., R. 11 E., is owned by W. W. Murphy, Milton. D. E. Coughanour worked the mine in 1921. D. J. Craig of Milton, A. M. and E. A. Hemming of Farmington, the present operators, leased and started working in November, 1934. The vein material consists of quartz and porphyry, and it strikes northwest and dips east. Two-thirds of the rock is base ore, containing iron and lead sulphides, with traces of arsenic and bismuth. Development includes an 84-ft. shaft with levels at 40 and 80 ft. Ore from the 18-inch vein at the end of the eastward 139-ft. drift on the 80-ft. level assays 38 ounces in silver and $9 in gold a ton. A 20-ft. winze has also been sunk on this level. An 80-ft. eastward drift on the 40-ft. level is being worked at the present time. A shipment of ore to Selby smelter in July, 1935, netted $25 a ton after all smelting and shipping charges were paid. Equipment consists of a Union air compressor and hoist, driven by gasoline engines. The last shipment of ore was milled in September, 1935, at a mill on Stewart's Ranch, 10 miles away. This mill includes a Straub concentrating table. It is planned to erect a mill at the mine in the near future. Three men are employed.

Gottschalk Mine, 1½ miles northwest of San Andreas, is owned by the Mrs. C. V. Gottschalk Estate, c/o C. L. Shinn, 1713 Burnett Way, Sacramento. The main Mother Lode vein consists of a mass of heavy white quartz croppings, striking northwest. The foot and hanging walls are a hard black slate and amphibolite schist, respectively. Most of the old development work has been done on a series of east-striking veins. Old workings include a 492-ft. shaft, which is connected to a 500-ft. tunnel on the 192-ft. level. There is a 400-ft. drift driven southeast below the tunnel.

Great Western Mine, 4 miles southwest of Sheep Ranch, on ridge between Indian and San Antonio creeks, was last prospected in 1934. W. D. Riley, Angels Camp, is the owner. There is a 2-ft. quartz vein striking N. 55° W. and dipping 65° NE. The mineralization is associated with a porphyry dike, and the country rock is a dark siliceous slate. Old workings include three tunnels; upper, middle, and lower; 175, 280, and 520 ft. in length, respectively.

Gumboot Mine, on Indian Creek, near Esmeralda, is owned by William Nuner, San Andreas. Workings include a shaft and a few hundred feet of drifting. Some highgrade ore was mined a few years ago.

Hardscrabble, or Bull Frog Mine, is 3½ miles west of Mountain Ranch, on ridge above Murray Creek. C. H. Kelley, Pasadena, has taken a bond and lease on this old property from Lindy Ketching and Louis Bauer, Camp Tamarack, owners. J. E. Munson and J. J. Bauer are manager and superintendent, respectively. They plan to deepen the 92-ft. vertical shaft sunk by Louis Bauer in 1928, and to prospect the two small quartz veins, which strike east and dip south. The hanging wall vein averages 3 inches in width and the footwall vein is almost 1 ft. wide, but both veins are expected to widen out at depth. There is a porphyry filling between the two veins. Both walls are slate. The ore, carrying pyrite and free gold, is said to average $30 a ton. The property will be equipped with a Giant compressor and hoist, driven by gasoline engines. Two men are employed at present. The early-day workings are not being developed. They consist of a 40- and a 100-ft. shaft, and a 300-ft. tunnel which has caved.

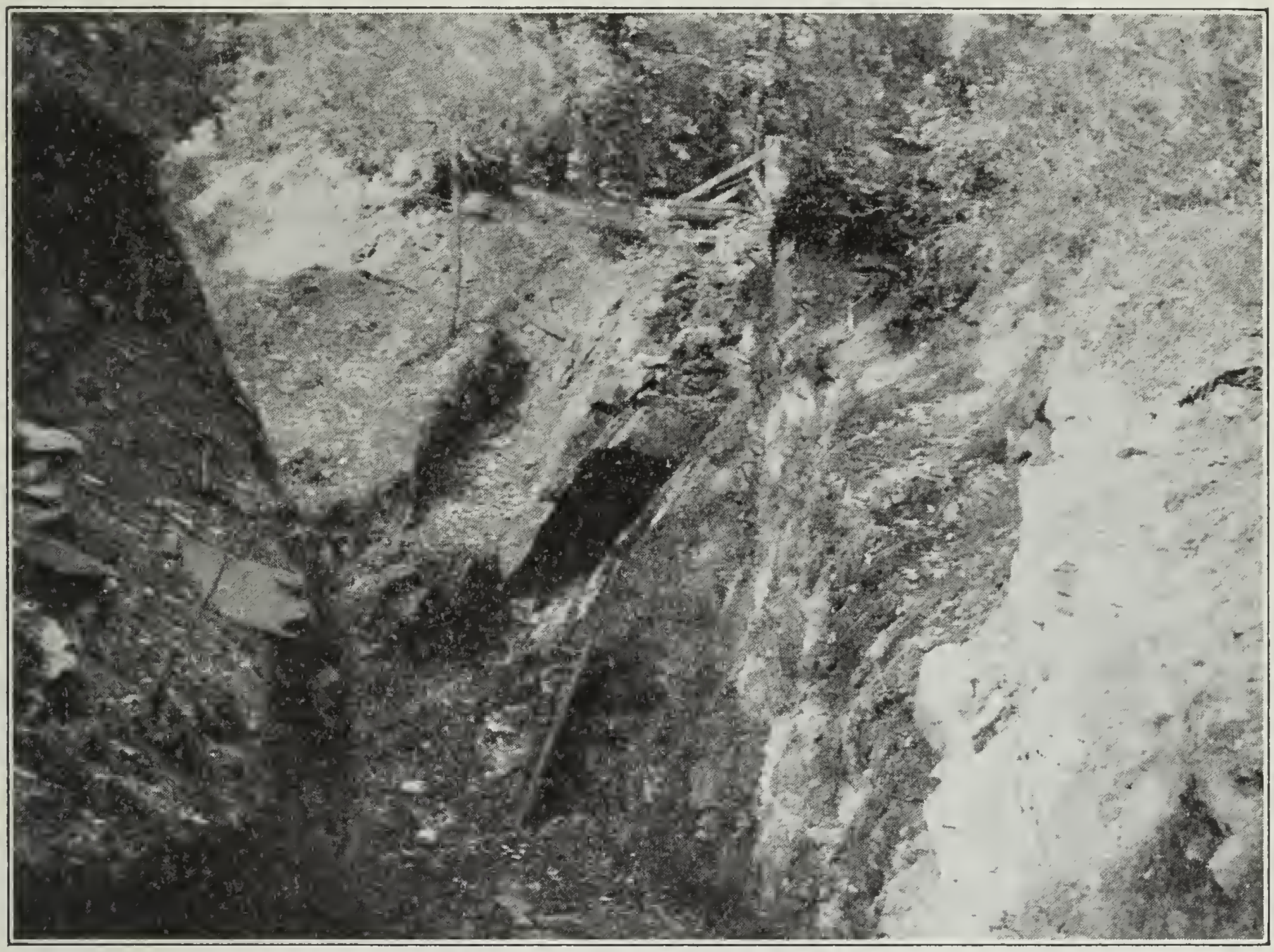

FIG. 6. Open-cut work on the principal vein of Heckendorn Mine.

Hazel Emma Mine, comprising 2 claims, 1½ miles northeast of Mountain Ranch, is owned by George W. Carr, Jr., Mountain Ranch. The vein, from 6 to 30 inches in width, strikes east and dips north. The ore contains free gold and sulphides. The country rock is slate. Development includes a 175-ft. adit crosscut northward to the vein, from which point the vein has been drifted on 50 ft. east and 50 ft. west. A 40-ft. vertical winze was sunk on the orebody at the end of the crosscut and a drift driven eastward for 30 feet when the ore pinched out. Money was not available to sink deeper or continue development, and operations ceased about 1933. A small ball mill was used at that time, and 25 tons of ore is said to have been treated that averaged $20 a ton.

Heckendorn Mine (also called *Blue Mountain*), is located 12 miles east of West Point, on the Buck Ranch Ranger road near Creichton, at an elevation of 4530 ft., in the Stanislaus National Forest on the Licking Fork of the South Fork of Mokelumne River. Mrs. Ernest Raggio, Angels Camp, owns the Heckendorn patented claim and two adjoining unpatented claims. This property, said to have been shut down since the seventies, was reopened September 19, 1935, by W. H. Gardner, 406½ Monroe Street, Los Angeles, lessee, with option to purchase.

The principal or middle quartz vein, averaging 4 ft. in width, strikes N. 3° W., and dips 61° W. Its outcrop can be traced about 1000 ft. and it had been developed by a 50-ft. shaft, from the bottom of which a drift was run northerly 150 ft. Gardner cleaned out this shaft and drift, and then commenced an open-cut operation on the middle vein about 50 ft. south of this old shaft. In the fall of 1935, 57,120 pounds of ore was sent from this open-cut to the Selby smelter. The smelter's assay on the ore showed: gold, 0.86 oz. per ton; silver, 4.10 oz. per ton; copper, 0.20%; arsenic, 0.05%; antimony, 0.20%; insoluble, 93.2%; iron, 3.6%; lime, 1.0%. Footwall is granodiorite, with a porphyry hanging wall.

There are two other veins on the property, an East vein striking north, dipping 78° W., and a West vein striking N. 16° W., dipping 42° W. Outcrop of East vein is said to be traceable 3000 ft. The East vein appears to be about 8 ft. wide in an old caved-in shaft. The West vein, about 30 inches wide, was developed by an old lower tunnel, driven 350 ft. northward.

Mr. Gardner ceased his development operations in the middle of November, 1935, on account of the weather, but planned to do more extensive work in the spring of 1936.

Hidden Treasure, Manhattan and *Tunnel Lode Claims* are 2½ miles west of Murphys, south of San Domingo Creek. T. G. Denslow and M. H. Manuel, Murphys, are owners. A Mr. Murrell prospected this old property about 1925, driving a short crosscut tunnel to the vein. In 1928 the *Hidden Treasure Mining Company,* under the direction of Will Hoyt and W. C. Gormley of Sacramento, took over the property and operated until about 1930. They stoped out some ore and treated it in a small cyanide plant, which was run for a few months. It is said that all of the values were not recovered by this treatment. The plant still remains on the property. Idle.

Hobo Mine, including the *Hill Top* and *Mauritas Claims,* in Secs. 19 and 30, T. 2 N., R. 12 E., is owned by the Jackson D. McCarty Estate, Copperopolis. This property, adjoining the Royal and Mountain King mines, has been only slightly developed. However, there is said to have been a fair production when last prospected in 1930 and 1931.

Ilex Mine (Tiger and Anglo-Saxon). M. Loughead, R. F. D. 1, Mokelumne Hill, has been prospecting vein outcrops on this property for some time, but has not reopened the old workings. It is in Sec. 35, T. 6 N., R. 12 E., six miles east of Mokelumne Hill and was actively operated in the 1880's, the last production of record having been made in 1888. Report VIII of the State Mineralogist (1888) described the mine in detail and stated the longest ore-shoot was 240 ft. long. A shaft was reported to have a vertical depth of 270 ft. that year, and the Tiger tunnel was reported 1000 ft. long, East Extension Tunnel

350 ft. long, and Anglo-Saxon Tunnel 180 ft. long. The main vein was reported to have mica-schist walls with a greenstone dike following the vein, and a north vein has granite walls. There is a series of veins, of which seven are shown on an old map, striking N. 70° E., and called from north to south the Intermediate, Beggar, South Tiger, Ilex, Ilex No. 2, Dry Gulch, and Dry Gulch No. 2 veins.

The recent work by Loughead is reported to have resulted in the accumulation of about 2,000 tons of ore at the several surface workings.

The Jackson folio[1] of the U. S. Geological Survey states that

> "The large quartz vein of the Ilex Mine at Rich Gulch has a course about north 80° east, and dips to the south about 35°. The country rock is a mica-chlorite-schist, and small amounts of the sulphides of iron, copper, lead, zinc and antimony occur in the ore, some of which shows gold to the naked eye. This vein was very thoroughly prospected and found not to contain a workable quantity of gold."

Independence Mine, 3½ miles north of Murphys, consists of 2 claims and 2 fractions. A partnership, consisting of Charles Marcum, W. H. and Louis Ladley, Alvin Bristol, and Clayton Murray, Murphys, own the property. The quartz vein strikes northwest and dips east. Both walls are slate. The gold is said to be mostly in the sulphides, although there is some free gold. The 5-ft. vein in the bottom of the 55-ft. vertical shaft is said to assay about $9.00 in gold. A 240-ft. tunnel has been driven into the hillside, 375 ft. below the shaft.

Ingomar Mine, comprising 100 acres, is 1½ miles northeast of Campo Seco, on ridge south of Mokelumne River. It includes the Ingomar, Gray Eagle, Star, Cora and Riverside claims. The *Ingomar Mining Company,* c/o J. J. Williams, Sacramento, leased the property from the owner, Arnoldo Moss, San Jose, and is now prospecting the mine.

The quartz vein lies between amphibolite schist and talcose slate, and has a width of 10 ft. on the outcrop. It strikes N. 30° W. and dips 60° NE. The copper and gold ore occurs in lens-shaped deposits in the schist, containing free gold, pyrite and galena. Old workings include a 500-ft. inclined shaft (S. 49° 40′ E.), with levels at 300, 380 and 500 ft. There is a drift 250 ft. northwest and 400 ft. southeast from shaft on the 300-ft. level. All of these old workings are under water. Joe Nunez and another man commenced driving a crosscut tunnel southwest in September, 1935. The tunnel is 100 ft. long, stated to lack about 40 ft. from cutting the vein. Equipment includes an air compressor driven by gasoline engine. The iron gossan croppings on the surface are said to have been rich in gold when worked many years ago.

Janie Boyd Mine, formerly known as the *Sanchez,* or *Holmes Mine,* in Secs. 2 and 11, T. 4 N., R. 10 E., ½ mile southeast of Campo Seco, was worked by R. T. Hamilton, 882 Cleveland Avenue, Oakland. The 247 acres of patented land is leased from a Mr. Holmes of Stockton and William Arbunarus, Campo Seco.

There are said to be twelve parallel quartz and calcite fissure veins, varying from 8 inches to 6 ft. in width. The ore contains free gold, pyrite, galena, sphalerite, and chalcopyrite. The country rock is slate and greenstone. The last development was on a vein 3 to 4 ft. wide, which strikes northwest. Development includes a 500-ft. adit driven southeast, and a 45-ft. inclined (40°) winze about 100 ft. from the portal of the tunnel. Another 185-ft tunnel had been driven southeast on the west side of the hill southeast of the quartz mine. When the mine was visited in December, 1935, Mr. Hamilton had begun to concentrate all work on some placer ground. However, he stated that 15,000 tons of $10 ore had been blocked out in the quartz mine. Ten men had been employed doing development work. There is no mill on the property.

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[1] See reprint of Sacramento, Placerville, Jackson folios (combined), p. 9.

Subsequently, the placer ground was sampled by means of a Spiro concentrator, and it is said to have tested about 50 cents a cubic yard. The placer ground was worked from February until May, 1936, when oprations were temporarily abandoned because more than half of the fine gold was being lost with the clay which is mixed with the sand and gravel. A total of six men had been employed three shifts daily. The ground was broken up by means of a 'rooter,' which was followed by two caterpillar tractors with scrapers, which dragged the material up an incline and allowed it to fall below into the gravel bin. A 26-ft. trommel, with inside baffle plates, washed the material. The gold was caught in a sluice lined with wooden riffles. The rejected material was stacked by means of a rubber conveyor-belt. A 20-h.p. electric motor drove the trommel, and the conveyor was driven by another small electric motor. Water was pumped from Campo Seco to a reservoir on the property, whence it flowed down to a small reservoir and was pumped to the washing plant. This plant was being tested for its efficiency by the operators in May, 1936, the gravel used being from a property near Mokelumne Hill.

Bibl.: State Mineralogist's Report XIV, p. 57.

Johnstone, L. G., Mine, adjoining the Annapolis mine to the north, both of which are said to be on a north extension of the Carlton vein, is a new prospect. The property was leased and work was started on it by L. G. Johnstone, 1405 City Hall, Los Angeles, on August 25. 1934. M. Donnallan, West Point, is the owner of the property, which is situated 1 mile northwest of West Point. The quartz vein, averaging about 4 ft. in width, strikes north and dips 55° W. There is a 110-ft. inclined shaft, from which drifts had been run 50 ft. south and 50 ft. north on the 50-ft. level. A crosscut was driven about 100 ft. eastward from this north drift. An 80-ft. drift was driven south on the 100-ft. level. The ore is said to average $16 per ton, 40% of the value being in the sulphides. Both walls are granodiorite. H. S. Wardell and a helper were keeping the mine unwatered with the use of a gasoline-engine driven jack-head pump when visited in November, 1935.

It is understood that the above operation was discontinued, and that Wardell commenced working the old *Continental Mine* on the North Fork of Mokelumne River in 1936. An old rotary mill from the Champion mine is being installed on the latter property.

Kaiser Wilhelm (Kaiser William) Mine, 5 miles southwest of Railroad Flat, is owned by Enright Estate Co. It is said to have been worked for a short period in 1935. Workings are said to include a 150-ft. vertical shaft and a 300-ft. tunnel driven in on the vein on the slope north of Calaveras River.

Jones Mine, 3 miles south of Angels Camp, is owned by M. H. Manuel, Murphy. The old 600-ft. shaft is now caved and no equipment remains on the property. The ore is said to be base, containing zinc and tellurides of gold and silver. Idle.

Kate Hageman Mine (formerly *Comet,* and *Gospel*), 2 miles north of San Andreas, is being operated by a partnership consisting of R. Hageman, Arthur Gorwood and D. C. Smith, of San Andreas. The property consists of 2 patented claims and millsites, totaling 49 acres.

Erection of a 10 (1000-lb. stamps) and 3 (1250-lb. stamps) stamp mill was commenced the latter part of 1935. Other equipment includes a 150-h.p. diesel engine with a 100-h.p. Bullock generator, 75-h.p. double-drum electric hoist, and a 300-cu. ft. Sullivan compressor. A Plato concentrating table is to be added to the mill. The operators had not commenced to develop the mine when the mill was erected, but a 9-ft. quartz vein exposed by open-cuts and old workings is said to assay $7 per ton, while some of the stringers in slate west of the vein are said to run $3 or $4 per ton. The vein strikes northwest and dips 51° E. The footwall is greenstone and the hanging wall, slate. The operators have sunk a 25-ft. shaft on the vein of the Gospel claim, and plans are to drift southeastward to the Comet property. Ore was being mined from an open cut alongside the shaft in May, 1936. Eight stamps were in use to mill this ore. Apparently the mine development has been slow due to lack of finances. From 12 to 15 men are employed two shifts daily.

Lamphear and *Moser Mines,* 1 mile south of Mokelumne Hill, were last worked from October, 1934 until February, 1935 by *Precious Metals, Inc.,* Buffalo, N. Y. The 300-ft. inclined Lamphear shaft was retimbered to a depth of 60 ft. and the mine unwatered. William W. Thayer, 1352 Van Ness Avenue, San Francisco, California manager of the organization, states that only a small amount of sampling was completed when he received orders to cease operations. He says that a large vein on the 280 level runs $5 a ton. This company did not mill any ore. The Lamphear vein strikes northeast and dips 45° SW. It pinches and swells between an amphibolite schist footwall and slate hanging wall. The inclined shaft in the footwall, with a dip 10° steeper than the vein, has levels at 115, 180 and 280 ft. Ore is reported stoped out to an inclined depth of 170 ft. An old crosscut at the 180-ft. level failed to show the vein.

A 20-stamp mill, plates, and two concentrating tables, installed about 14 years ago, and a Sullivan compressor, electric hoist and electric motors, remain on the property. William W. Thayer still retains an option on the group.

Last Chance Claim is located about 3 miles southwest of Mountain Ranch; John Guth, Mountain Ranch, owner. West and east tunnels are 75 ft. and 200 ft. long, respectively. The property was recently optioned to a Mr. Warren of Los Angeles, but no development has yet commenced.

Last Chance and *Great Divide Mines* are 2½ miles west of Murphys, on ridge between Angels and San Domingo Creeks; G. L. and E. F. Mitchler, Murphys, owners. A partnership consisting of Walter

Heidrick, Jack Richmond, Fred Zurcher and Ben Martin of Murphys cleaned out the old workings on these two properties and treated 26 tons of ore from the old dumps at the *Fairplay mill.* This 5-stamp mill is 3 miles northwest of Murphys, on San Domingo creek, and is owned by Lawrence Monteverde, Angels Camp.

The Last Chance has a 100 ft. shaft, and the Great Divide has 25- and 50-ft. shafts. There are two parallel quartz veins striking east. The formation is mica schist.

La Verne, Monte Cristo, Sarah Al, Mary V., and *La Franchi* claims, situated about ½ mile east of the old town of Glencoe, are owned by Joseph S. Wright. J. A. Wright is prospecting the La Verne claim. A 70-ft. crosscut tunnel has been driven to the vein, which strikes northeast and dips eastward. Drifting has been started on the 6-ft. vein.

Legal Tender Mine is 5 miles north of Murphys, on ridge between Indian and San Antonio creeks. Legal Tender vein strikes east and dips 80° S. The ore is free milling. A 147-ft. crosscut tunnel taps the bottom of an old 110-ft. shaft. The lower 206-ft. crosscut tunnel was extended 116 ft. by George Gearhart in 1933. This lower tunnel is said to have cut across three veins, but lacks 90 ft. of striking the Legal Tender vein. George S. Taylor, Murphys, is the owner. Idle.

Liberty Bell No. 1, 2, and 3, including *Wagner* and *Santa Maria* claims, in Sec. 21, T. 6 N., R. 13 E., 12 miles northeast of Mokelumne Hill, are owned by Ed King and W. T. Treat of San Andreas. This property is west of the old *Wolverine* mine and north of the *Poorman* mine, on ridge ½ mile south of the South Fork of Mokelumne River.

There are three small quartz veins, varying from 6 inches to 5 ft. in width, which strike northward, more or less parallel to each other. The ore contains free gold, pyrite, and some galena. The footwall is slate and the hanging wall is granite. Old workings include the 80-ft. inclined Wagner shaft, from the bottom of which a vein 2 ft. in width has been drifted on a distance of 60 ft. southward. This ore is said to average $18 a ton. Mr. King is employing one helper in the present prospecting. It is planned to install an air compressor to permit further development, and then erect a ball mill, amalgamation plate, and concentrating table.

Little Gulch, Opal and *Red Wonder* claims are 2½ miles east of West Point, ¼ mile west of the Lockwood mine, apparently in Sec. 1, T. 6 N., R. 13 E. Carroll Evans and D. E. Hayes, 1144 Yale Street, Santa Monica, owners, have given a bond and lease on the property to Lawrence T. Baker of the Albatross Steel Furniture Company, Ltd., West Los Angeles. The property was divided and separate portions subleased to a Mr. Hale, Gerlock, Jones, Gray, and Spalding in 1935. Wallace Brothers, Pomona, for whom W. G. Spalding is superintendent, have now taken over most of the ground of the other lessees.

A series of small parallel, high-grade quartz veins are said to traverse the property. The Ferrin vein, developed by Spalding and Gray, is from 6 inches to 3½ ft. wide, strikes north and dips 80° W. A small amount of talc gouge appears on the side of the vein. Several diorite dikes intersect the vein, and the best ore is found near this intersection, especially on the south side of the dike rock. The ore is heavy in sulphides, consisting mainly of pyrite, arsenopyrite and a little galena. Both walls are granodiorite.

Workings consist of a 90-ft. vertical shaft, with levels at 45 and 90 ft. There is about 125 ft. of drifting eastward on the 45-ft level, from which some high-grade ore was shipped to the Selby smelter, said to average from $90 to $220 a ton. A 30-ft. drift, eastward, along the dike, has been driven on the 90-ft. level. When visited in November, 1935, there had been a cave-in, and the vein had been lost. A later communication from Hayes states that this difficulty has been overcome and ore is again being shipped from the vein. He also states that the shaft is to be deepened. The main, Little Gulch vein, is expected to intersect the Ferrin vein at the 250-ft. level.

Equipment includes a Rix compressor and hoist, both driven by gasoline engines. Three men are employed.

Former lessees to the north and northeast of the Spalding-Gray shaft made the following development: Hale vertical shaft, down 100 ft., had not reached vein; Gerlock shaft, down 90 ft., cut 3-ft. vein; Jones shaft, down 50 ft., said to be west of vein.

Lockwood Mine, 2 miles east of West Point, has been leased by John Rogers, Mojave, from Mrs. Goodwin of Los Angeles. D. B. Winiker is superintendent.

The present operators, who commenced in the spring of 1936, are confining their work to deepening the Austrian shaft. The Austrian vein is said to be practically parallel to the Lockwood vein, also striking N. 23° W. and dipping 80° W. The inclined shaft had been deepened to 195 feet in May, 1936. The quartz vein averaged 1 ft. in width at this depth. The old 155-ft. level is not to be reopened, and plans are to start a new station at 230 ft. and drift northward. Both walls are granodiorite. Equipment includes a single-drum hoist driven by a gasoline engine, a combination Chicago-Pneumatic diesel engine and 200-cu. ft. air compressor, and an electric generator driven by a gasoline engine. A total of 16 men are employed three shifts daily.

There are two other shafts on the Lockwood property. The main Lockwood shaft, 430 ft. in depth, as well as the Austrian shaft, were previously worked by a Mr. Hughes of Los Angeles about 1933. Old milling equipment of the Lockwood consists of a Lane Chilean mill, flotation unit, and a concentrating table. The present operators do not plan to use this mill.

Lookout Mountain Mine, 2½ miles northwest of San Andreas, is controlled by the *Lookout Mountain Mining Company,* Box 112, Mokelumne Hill. Rees Davies is president and general manager; Elmer T. Prather, vice president. The holdings include a lease on 70 acres belonging to Bill Robinson and Mrs. Casey, Mokelumne Hill, and 170 acres owned by Henry Espanola, San Andreas. This company has operated at intervals since 1931.

The vein material consists of low-grade mineralized quartz and amphibolite schist, up to 60 ft. in width. It strikes northwest and dips east. The hanging wall is porphyry, and the footwall is believed to be slate. Over $175,000 is said to have been spent on this property, principally upon changing the mill three times, instead of proper development of the mine. The mine development includes a 50-ft.

adit driven southeastward, at which point three drifts branch out for a total distance of approximately 2000 ft., which crosscut and drift with the vein at places. A 100-ft. underground shaft, with a level at 80 ft., is also sunk at the above mentioned point. A 20-ft. drift had been driven eastward and a 100-ft. drift driven parallel but not on vein from this 80-ft. level. Rees Davies, who has taken over the management from E. T. Prather, plans to change the present mine development as soon as money is available.

Some ore from the *Etna* mine, 1 mile northwest, had been milled in the fall of 1935, but the mill was forced to close down about October because of lack of water. A sufficient water supply is now said to be available from the nearby creek. It is raised 100 ft. to the mill by means of an electric turbine-pump. The mill consists of a 50-ton Huntington mill, amalgamation plate, and two Plato concentrating tables. Davies planned to replace the Huntington with a ball mill. Other equipment includes a tugger air-hoist for the underground shaft, and an Ingersoll-Rand air compressor driven by a 50-h.p. motor. The property was idle early in December, 1935.

This company commenced milling ore in the above mill in March, 1936, which was being hauled ½ mile by 3-ton truck from the *Golden Hill* mine. A vein, about 8 ft. in width, consisting of quartz and amphibolite schist, was being mined from an open cut on the Golden Hill property. This ore is said to assay $1.70 to $3.50 a ton, and 1007 tons had been milled up to May 15, 1936. No attempt was being made to amalgamate the free gold, and all recovery is from the concentrates, which are said to average $90 a ton. From 70 to 75 tons of ore yield a ton of concentrates. The Golden Hill mine is owned by Ida Davies, Oakland, and F. G. Carey. Old workings at the mine include a 350-ft. inclined shaft (caved), and a 100-ft. vertical shaft. A total of 12 men were employed by the Lookout Mountain Mining Co. for three shifts in May, 1936.

Lopez Mine, on ridge north of San Antonio Creek, near Esmeralda, is owned by Jesus Lopez, Esmeralda. Old workings include a 180-ft. shaft sunk on the vein. No recent development except the annual assessment work.

Lucky Boy Mine, comprising *Lucky Boy No. 1 and No. 2, and Heidler Gem Claims,* is located 2 miles northwest of Railroad Flat. M. R. Crane, Railroad Flat, obtained a lease on the property from William Davis of Oakland, and commenced operations in April, 1934. There is a quartz vein from 12 to 20 inches wide that strikes northeast and dips 70° SE. The ore is base, with some free gold. Workings include a 38-ft. shaft, from the bottom of which there is a 100-ft. drift on vein, and there is also a 100-ft. drift northeast on vein from surface. There is also a 310-ft. crosscut tunnel. Ore was stoped from between the upper and lower 100-ft. drifts. Operations had just ceased and the equipment had been sold, when the property was visited in November, 1935. The equipment included a jaw crusher, ½-ton Ellis ball mill, amalgamation plate, two Lynch concentrating tables, air compressor and gasoline engine. Three men had been employed.

Lucky Jim and Gold Ridge Claims are located 2½ miles southwest of Mountain Ranch, on the east side of Murray Creek. Maude E.

Gerry, owner. Development consists of small shaft and tunnel. Hamby Bros., Mokelumne Hill, are said to have worked the property about 12 years ago. A Mr. Harris last worked the claims, about two years ago. Idle.

Maria and Fortuna property, embracing 4 claims and a millsite, near Esmeralda, formerly worked by the *Indian Creek Gold Mining Company,* is owned by George S. Walker, Flatiron Building, San Francisco. There are said to be three veins, the Maria, Bence, and another, striking northwest and dipping northeast. Workings include the old 154-ft. Maria shaft and an old 400-ft. adit tunnel which never reached the Maria vein. The Maria vein material is said to be from 12 to 20 ft. in width, averaging about $3 a ton. A 650-ft. adit tunnel was driven southeast on another vein by the last operators. This vein is about 5 ft. in width at the end of the tunnel, and is said to average about $9 a ton, all values in sulphides. The workings are now partly caved. Idle.

Mar John Mines Company, controls 312.8 acres in Sec. 21, T. 4 N., R. 14 E., six miles north of Murphys, on Indian Creek. The property embraces the *Old Calaveras Group* (*Enchantress* and *Oro Minto* patented claims), the *Washington Pescia* ground, *South Bank* claim, and some patented agricultural land. The Mar John Mines Company received a California corporation stock-sales permit on July 14, 1924, but this was suspended on March 7, 1925. They then organized a common-law trust under the Nevada laws, issuing 3 million shares of stock, 2 million of which went to the trustees. Entire control of the company is in the hands of the trustees, J. T. and E. E. Martin, P. B. Russell and J. Ellery Robertson. Officers are: John T. Martin, Sheep Ranch, president; E. E. Martin, 1465 Oak Street, San Francisco, secretary; P. B. Russell, mine superintendent.

The Old Calaveras Group was worked as early as 1872, and had a 20-stamp mill. President Martin states that previous to 1924, when Mar John Mines Co. acquired the property, the Old Calaveras (Enchantress) mine had been opened to a depth of approximately 200 ft. and that the Enchantress also produced down to a depth of 50 ft. Most of this production was in the middle 1870's and 1880's. At that time the Enchantress shaft was deepened to 110 ft., and a good grade of ore reported found on the 100-ft. level.

Mar John Mines Co. did not commence active operations on the property until the latter part of 1928, continuing until 1933, when operations stopped. Work was resumed in May, 1934, and has continued since then.

The property is worked through the Calaveras shaft, 450 ft. deep. Drift levels are at 120, 240, 350 and 450 ft. Considerable stoping has been done between the Calaveras and Scalawag shaft, 240 ft. apart, the latter shaft being 350 ft. deep. Most of these stopes are from 3 to 4 ft. in width. Practically all of the present work is between the 240- and 350-ft. levels, but plans are to commence development between the 350- and 450-ft. levels soon. The Enchantress shaft, 110 ft. deep, now caved, had levels at 50 and 100 ft.; but is now developed through a crosscut from the 350-ft. level of the Calaveras workings. A 580-ft. crosscut has also been run northwest to the Washington Pescia ground. Open stope and shrinkage mining methods are used.

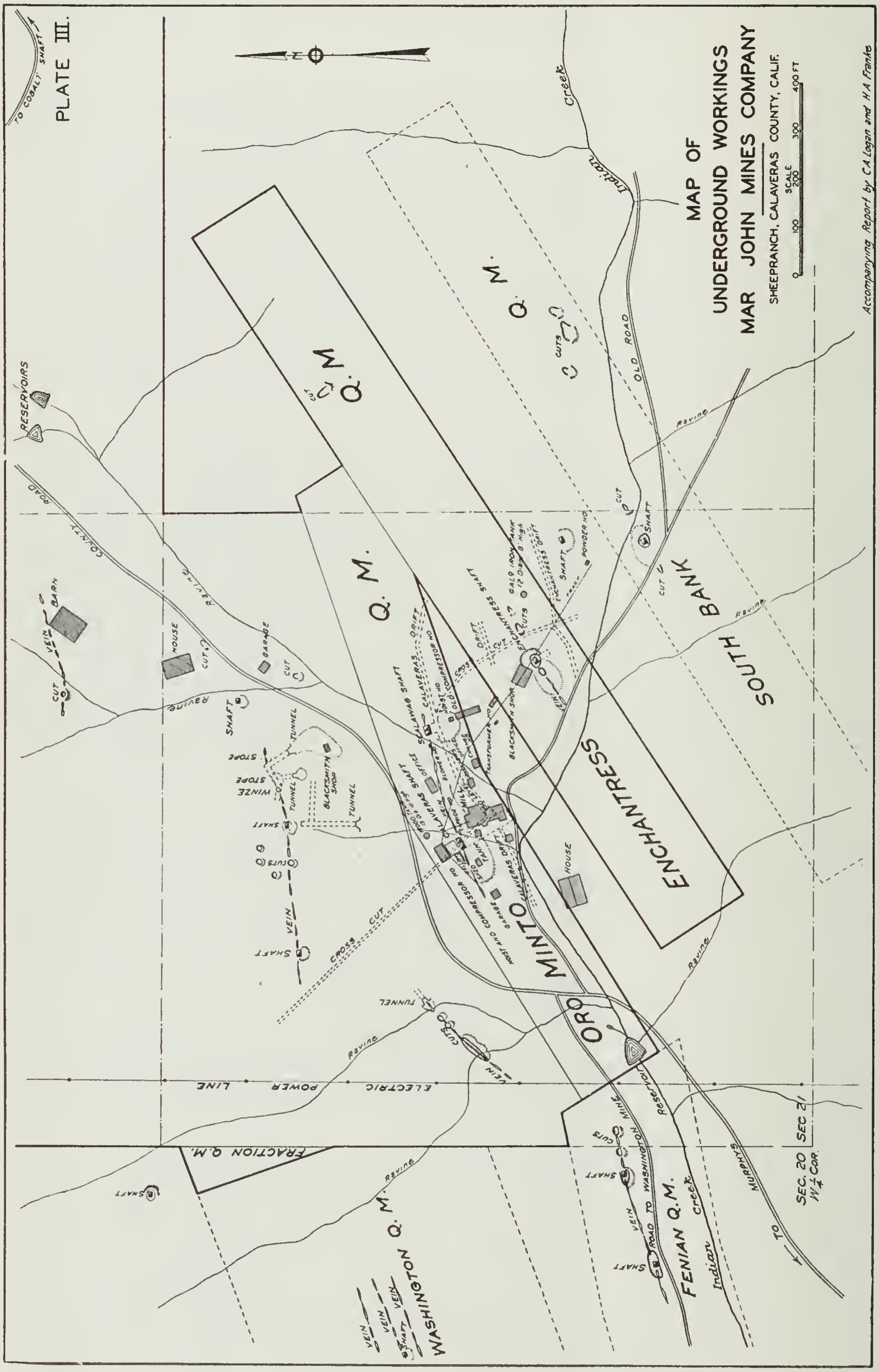


PLATE III.

MAP OF
UNDERGROUND WORKINGS
MAR JOHN MINES COMPANY
SHEEPRANCH, CALAVERAS COUNTY, CALIF.

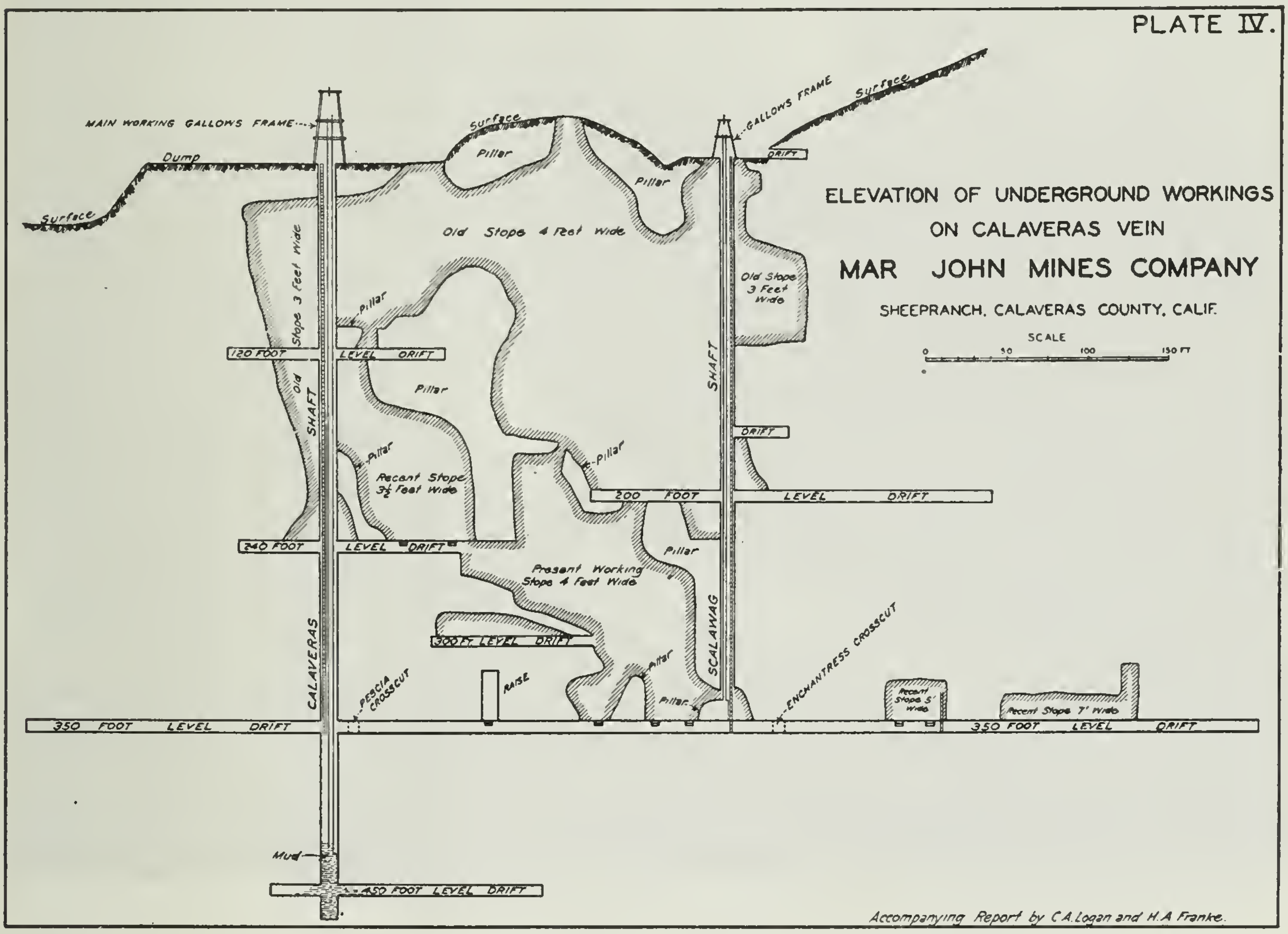
Accompanying Report by C.A. Logan and H.A. Franke

SCALE
0 100 200 300 400 FT
TO COBALT SHAFT
RESERVOIRS
COUNTY ROAD
BARN
VEIN
CUT
HOUSE
GARAGE
Ravine
SHAFT
STOPE
WINZE
TUNNEL
BLACKSMITH SHOP
CUTS
CROSS CUT
Q. M
Q. M.
Indian Creek
OLD ROAD
CUT
SHAFT
POWDER HO.
ENCHANTRESS SHAFT
SKALAWAG SHAFT
CALAVERAS SHAFT
OFFICE
CALAVERAS DRIFT
COMPRESSOR HO.
MILL
TANK
HOIST AND COMPRESSOR HO.
BLACKSMITH SHOP
TRANSFORMER HO.
DRIFT
ENCHANTRESS
SOUTH BANK
MINTO
ORO
ELECTRIC POWER LINE
FRACTION Q.M.
WASHINGTON Q. M.
FENIAN Q.M.
ROAD TO WASHINGTON MINE
Reservoir
TO MURPHYS
SEC. 20
SEC. 21
W¼ COR.

There are said to be five veins traversing the property, the Calaveras, 3 to 4 ft. wide; Washington Pescia, 6 ft.; Intermediate, 20 inches; Enchantress, 2 ft.; and the South Bank vein, 2.5 ft. The principal, Calaveras vein, strikes N. 70° E and dips 70° SW. It is in the Calaveras formation, and carries free gold, pyrite, galena and a little zincblende. Values are found in the quartz and adjoining quartzite and slate wall rock. Both walls are slate.

The grinding equipment consists of a Joshua Hendy 8 by 12 jaw crusher, 10-stamp mill (1000 lb. stamps), 4½ ft. by 3 ft. Colorado Iron Works ball mill, in closed circuit with a Dorr classifier and corduroy blankets. Other mill equipment includes Martin's hydraulic pulsating gold trap, 2 Denver Sub-A flotation cleaner cells, 2 Kraut rougher cells, 1 K. and K. rougher cell, and 2 Denver filter tanks for flotation concentrates. The concentrates are sent to the Amador Metals Reduction Co., Jackson, and table amalgam to the U. S. Mint at San Francisco. About 14 tons of ore are being milled daily. There is an electric hoist, 1050-cu. ft. Ingersoll-Rand compressor, drill sharpeners, tugger hoist, and blower. A total of 12 men are employed, including 5 underground.

PLATE IV.



ELEVATION OF UNDERGROUND WORKINGS ON CALAVERAS VEIN

MAR JOHN MINES COMPANY

SHEEPRANCH, CALAVERAS COUNTY, CALIF.

Accompanying Report by C.A. Logan and H.A. Franke.

SCALE
0
50
100
150 FT
MAIN WORKING GALLOWS FRAME
Dump
Surface
Surface
Pillar
Pillar
GALLOWS FRAME
Surface
DRIFT
Old Stope 4 Feet Wide
Stope 3 Feet Wide
Old Stope 3 Feet Wide
Pillar
120 FOOT LEVEL DRIFT
Old SHAFT
Pillar
SHAFT
DRIFT
Pillar
Recent Stope 3½ Feet Wide
Pillar
200 FOOT LEVEL DRIFT
240 FOOT LEVEL DRIFT
Pillar
Present Working Stope 4 Feet Wide
300 FT. LEVEL DRIFT
CALAVERAS
SCALAWAG
PESCIA CROSSCUT
RAISE
Pillar
Pillar
ENCHANTRESS CROSSCUT
Recent Stope 5' Wide
Recent Stope 7' Wide
350 FOOT LEVEL DRIFT
350 FOOT LEVEL DRIFT
Mud
450 FOOT LEVEL DRIFT

About 1925 this company commenced an operation on the upper northeastern end of their property where cobalt with radium and other rare-earth metals were reported. This Division made an investigation of these claims, and samples taken from a small lens of 'ore' uncovered in shaft-sinking did show a small bunch of smaltite (arsenide of cobalt), but not in commercial amount. No rare-earth metals were found. The Mar John Mines Co. maintained a special laboratory at 342 Fifth Street, San Francisco, at that time, but no production of rare-earth metals by use of this special equipment is known to have been made.

The company abandoned the cobalt development in 1930, after working to a depth of 175 ft., and have lately devoted their time to gold.

Mascot Mine is 5 miles east of Murphys, on Bald Mountain. The vein, 2 ft. in width, strikes east and dips 40° N. There is a 225-ft. tunnel. The old 85-ft. shaft has caved. A 5-stamp mill is on the property. G. E. Mayer is now prospecting the mine. George S. Taylor, Murphys, is owner.

McKisson, or Etna Mine, owned by the McKisson Estate, Mokelumne Hill, is situated 1 mile north of the former town of Glencoe, on the south slope above the South Fork of Mokelumne River. *Consolidated Mines of California,* 634 S. Spring Street, Los Angeles, commenced developing this property in December, 1933. Officers of the company are: Frank Wikoff, president; W. J. Morgan, executive vice president; R. H. Lytle, business manager; Frank S. Tyler, secretary; L. D. Gilbert, mine superintendent.

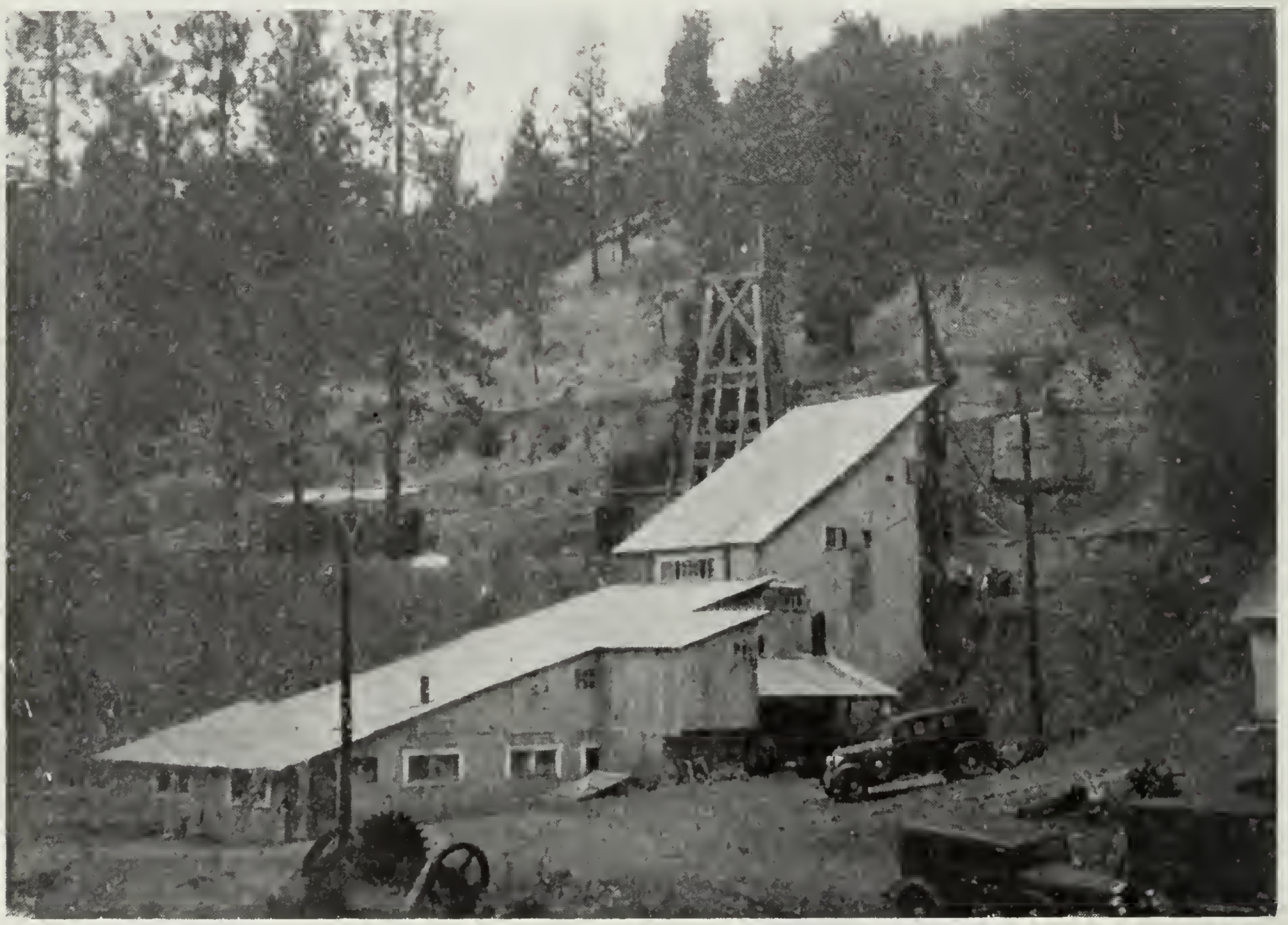


FIG. 7. Mill and headframe of Mar John Mines Company.

There are two quartz fissure-veins striking a little north of east, dipping 75° S. The ore occurs in lenses, and varies from 6 inches to 4 ft. in width. The ore is said to average about $20 a ton. It is base, with some free gold. Both walls are granodiorite. The lower Ditch tunnel level has opened up the vein for 1020 ft. and the Mill tunnel level is a 717-ft. drift on the vein. A 178-ft. raise connects the two tunnels. Enough ore is said to have been developed during the past two years to justify a 5-stamp mill, which was being erected when the property was visited in November, 1935. The mill will be equipped with amalgamation plate and three Denver Sub-A No. 12 flotation cells.

There is also a 125-cu. ft. semi-portable Ingersoll-Rand compressor. All machinery is driven by gasoline engines. Ten men were employed in building the mill.

Mervy Prospect adjoins the Black Bart mine, 6 miles northeast of Copperopolis. L. Mervy, Copperopolis, has driven a 130-ft. tunnel in the porphyry footwall toward the quartz ledge which strikes northwest. The hanging wall is said to be Mariposa slate.

Mikado Mine, ¼ mile south of Railroad Flat, is owned by M. E. Taylor, Railroad Flat. A Mr. Striker has commenced to work the mine through the old 130-ft. inclined shaft. There is said to be a 3-ft. vein, striking north and dipping east. The ore contains galena, sulphides, and some free gold.

Mitchell, or Martin Mine, comprising 45 acres owned by the estate of Mills Mitchell, Vallecito, is 5 miles south of Copperopolis, on Black and Sawmill creeks. J. H. Bowie of Copperopolis, leased the property and plans to commence operating it at an early date. An electric power-line to the mine has been erected.

There are two parallel veins, consisting of quartz and porphyry stringers from 6 inches to 3 ft. in width. They strike northeast and dip east. The ore carries free gold and sulphides. The country rock is slate. Old workings consist of a 35- and an 80-ft. shaft, 55 ft. apart. Equipment includes a 125-cu. ft. Gardner-Denver air compressor and a Fairbanks hoist, driven by a 15-h.p. Fairbanks motor.

M. J. B. Mine, 4 miles south of Railroad Flat, is owned by C. Burns, Railroad Flat. Harry A. Harper of Sacramento is now operating the property. The principal quartz vein, from 1 to 2 ft. wide, strikes east. The vein has been developed by a 65- and a 120-ft. drift from the 120-ft. shaft. Equipment includes hoist and pump, driven by gasoline engine. A 3-stamp mill is not now used. Three men are said to be employed.

Mohawk Mine, is 2 miles from Angels Camp on the Copperopolis road. Mrs. Minnie Raymond and J. G. Dunleavy, Altaville, and John Heith, owners.

Development includes a 200-ft. inclined shaft, with levels at 100 and 200 ft. There is a 300-ft. crosscut northeastward on the 100-ft. level which has developed a stringer lead of quartz and schist. See Report XXI of State Mineralogist, page 156. A 350-ft. drift was driven on the 200-ft. level. The mine was worked intermittently from January, 1934, until July, 1934. Now idle.

Morning Star, or Kuhn Mine, and the *Dublin Claim,* 3½ miles northwest of Copperopolis, were operated from November, 1935, to January, 1936, by L. V. Riddle, M. B. Dudley and associates, 832 Merchants' Exchange Building, San Francisco. There is a series of quartz veins and diabase dikes outcropping on the property. The quartz veins strike northwest and dip 45° NE. A model 40, Byers gasoline shovel, ⅜-cu. yd. bucket, was used to mine the ore and load it on a 4-ton truck, which hauled the material ½ mile to the Royal mill for treatment. Approximately 2,000 tons was treated, which is said to have averaged $5.35 a ton. Operations are said to have ceased due to damage by heavy rains and insufficient capital. The

Morning Star property is owned by Mrs. Kate Greenhaugh, Knights Ferry, and the Dublin belongs to Mrs. Phoebe Gerow, 725 20th Street, Oakland.

The *California Osborn Mining Company,* 333 Montgomery Street, San Francisco, leased the Morning Star property and obtained an option on an adjoining 1100 feet of land in February, 1936. They have 9 men employed in digging open-cuts to block out ore. They estimate that 50,000 tons of ore has been blocked out, averaging $3 to $4 a ton. The Byers shovel, mentioned above, has been purchased, and plans are to load the material on trucks and let a contract to haul it for treatment at the new mill being constructed at the Osborn Mine. Present equipment includes a 300-cu. ft. portable air-compressor driven by gasoline engine.

Mother Lode Central Mines, Inc., 216 Pine Street, San Francisco, owns the *Marble Springs and Bullion claims,* 1½ miles south of Angels Camp, on Albany Flat. Officers of the company are: Chas. J. Dilke, president; Wm. E. Lass, vice president and treasurer; Miss M. G. Mulvany, secretary; F. L. MacPherson, mine superintendent.

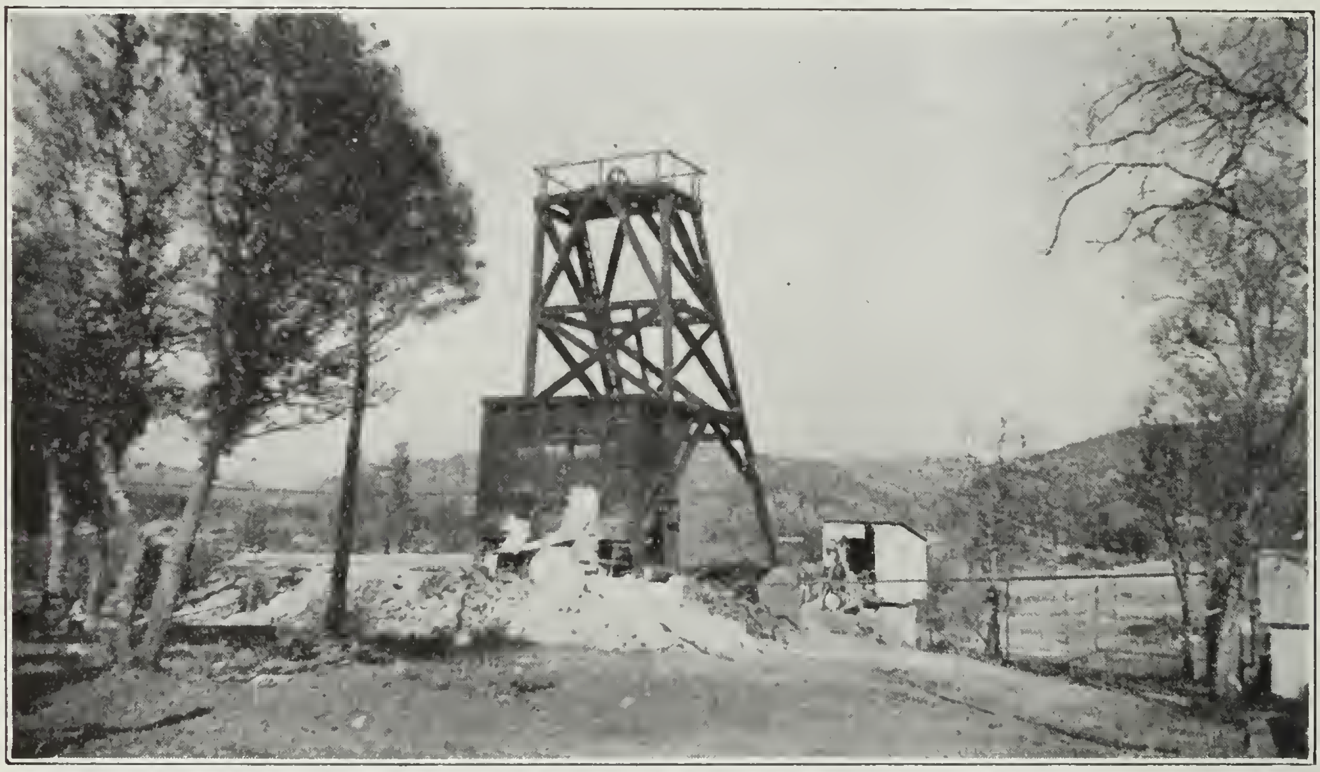


FIG. 8. Headframe on property of Mother Lode Central Mines, Inc.

The Bullion claim was worked over 30 years ago, and is said to have been developed through a 150- or 200-ft. shaft. The present operators have sunk a new 200-ft. inclined 72° three-compartment shaft on the Marble Springs claim. A station was cut at the 190-ft. level, and a crosscut driven 106 ft. eastward to the vein. This crosscut was extended 50 ft. beyond the quartz vein, but nothing of value encountered. A drift has now been driven southeast on the vein for a distance of 300 ft. This drift is to be continued along the vein and connections made with the Bullion vein. The vein ranges from 8 to 25 ft. in width and dips 65° E. The footwall is greenstone and the hanging wall is slate. The ore is said to average $7.20 a ton.

The present company commenced its development program in November, 1934, but all ore is being treated at the Russell mill. Approximately 15 tons of ore was being treated daily in May, 1936.

Plans are to sink the shaft another 200 ft. before erecting a mill of their own. Equipment includes an air hoist and a 780-cu. ft. Ingersoll-Rand compressor, driven by 75-h.p. General Electric motor. Nine men are employed one shift at the mine.

Mountain King Mine, formerly *Lillian,* includes the *Last Chance* and *Bulger Consolidated, William R., Magee, Collar and Elbow Lode,* and *Hodson Consolidated claims.* This property, which adjoins the Royal mine on the northwest, is 3 miles northwest of Copperopolis, and is owned by R. B. Parks, Clark Hotel, Stockton.

A former report, quoting from Byron E. Rowe, states:

> "* * * the veins are in the amphibolite schists at the contact with the Mariposa slate, mineralization being controlled largely by numerous fractures and intrusions of small veins of quartz which traverse the amphibolite schist in all directions and exhibit heavy mineralization wherever contacting the vein."

The principal vein strikes N. 60° W. and varies in dip from 31° to 20° northeast. The vein averages 5 ft. in width, with a maximum of 50 ft. The footwall is black slate. The main shaft is a 28° incline 1250 ft. (?) deep. The development is well described on page 156 of Report XXI of the State Mineralogist.

Byron Rowe last operated the 400-ft. Bulger shaft, 1000 ft. northwest of the Mountain King shaft. The operator is said to have discontinued all operations in 1930 after a 400-ft. drift driven south on the 150-ft. level encountered considerable black gouge. Some ore was stoped from between the 100-ft. level and the surface, and was milled in the Mountain King mill.

Joe Peltor, Joe Eralda, Eddie and Stanley Gilbert of Hodson sank a 40-ft. inclined shaft about 150 ft. north of the Mountain King shaft in the summer of 1932. They are said to have mined 95 tons of ore and treated it at the Royal mill, from which some free gold and 1400 pounds of concentrates were recovered.

Equipment on the property includes a 10-stamp mill, 750-cu. ft. compressor, shop and other buildings. Idle, though plans are reported being made to reopen at an early date.

Mount Bullion and Yellow Bird Claims are adjoining, in Sec. 23, T. 4 N., R. 13 E., 4 miles southeast of Mountain Ranch, near the former site of Cave City, on O'Neil's Creek. They adjoin the old Wheelock mine. F. A. and E. A. Thomas, Mountain Ranch, owners, have prospected these claims for the past few years. A quartz ledge, from 3 to 15 ft. in width, strikes east and dips south. There is a 100-ft. crosscut driven northwest to the vein, from which point the vein has been drifted on 100 ft. eastward. The ore contains free gold and some sulphides.

Murphy Divide Mine embraces 18 acres of patented land, ½ mile east of Murphys, owned by Frank Grenitta, Douglas Flat. Don Steffa, Murphys, and Thomas H. Lipps, Los Angeles, leased the property and commenced sinking a new shaft in June, 1934. The new shaft is down 150 ft., with levels at 50, 100 and 150 ft. There is about 125 ft. of drifting on the three levels. The quartz vein strikes northwest and dips east. It is a replacement vein in limestone. The ore is said to carry from 20 to 60 oz. in silver, 2 oz. in gold, and 10% lead. The large amount of galena is unusual for this vicinity. An old 100-ft. shaft, sunk in 1918, is not used. Equipment includes a compressor and hoist, driven by gasoline engines. Plans are to deepen the present shaft and crosscut to the vein. Ore will be shipped to a smelter .

Nancy Ann, or *Donner Mine,* in NE¼ of Sec. 6, T. 2 N., R. 11 E., 4 miles northeast of Milton, owned by Elmer L. Hunt, Milton, was leased to H. L. Donner of Milton in July, 1934. A 10-stamp mill was nearing completion when the property was visited in December, 1935. Two amalgamation plates and two concentrating tables will be used in the milling process. A 25-h.p. gasoline engine will furnish power for the mill. The ore is to be trammed 600 ft. to the 30-ton and 100-ton ore bins, from which the ore will be fed to a Gates gyratory crusher. The old mine has not yet been developed, except for surface open-cuts. This surface rock is said to test about $6 a ton. The mineralized zone strikes northwest. A piece of rock picked from the old ore dump near two old 40-ft. inclined shafts appeared to be a silicified volcanic rock, probably a silicified andesite. Three men are employed.

Norwich Mine, formerly Nucleus, is 9½ miles northeast of Mokelumne Hill, and is owned by the *Norwich Mining Company,* Mokelumne Hill, of which G. A. Scott is president. K. E. and W. E. Burton took an option and lease on 120 acres of this ground, and commenced operations September 7, 1935.

The Norwich quartz vein, which outcrops for 2200 ft., varies from a few inches to 12 ft. in width. It strikes northeast and dips 50° E. The ore, containing sulphides, galena, and free gold, is said to average about $18.00 a ton. There are also some small intersecting veins, striking almost east. The wall rocks are both slaty schist. The old development includes a 200-ft. inclined (45°) shaft, with levels at 125 and 200 ft. Ore above the 60-ft. southward drift on the 125-ft. level is said to have been stoped up to the surface in the early days. The vein was opened for a length of 400 ft. on each side of the shaft on the 200-ft. level. Seven men were employed in cleaning out the old workings when the property was visited in November, 1935. An upright steam boiler was being used to operate the hoist and Worthington pump. These operations are reported to have been discontinued the early part of 1936, and the mine is now said to be optioned to Joe King, San Andreas.

Ohio Mine is 3½ miles north of Murphys, on Indian Creek; Jack Klare, 238 Castle Street, Modesto, owner. Old workings include a 300-ft. shaft, an upper tunnel 125 ft. long, and a lower 400-ft. tunnel. Some prospecting was done here recently, but it is now idle.

Oro y Plata Mine, consists of 153 acres of patented land, known as the *Oro Plata, Oro-Plata Extension, Pay Rock, Red Wing and Silver Star Lode Claims, Henry Wigmann Placer Claim,* and portions of Lots 8, 18, 21, 22, 23 and 24, Block 7, Murphys townsite, all located in Secs. 5 and 6, T. 3 N., R. 14 E. After an idleness since 1888 the *Union Consolidated Mining Company,* the present owners and developers, acquired and commenced operations on the property in 1926, continuing operations until July, 1930. A New York syndicate, headed by Frank Eichelberger, leased and worked the mine from 1931 until March, 1932. Since April, 1934, the *Union Consolidated Mining Co.* has been prospecting the property intermittently, under the direction of Superintendent J. C. Scoles. The company's address is 155 Montgomery St., San Francisco; J. H. Weston, president; George Searle, secretary.

The geology of this property is complicated. A number of economic veins exist, and apparently the mineralization occurs in connection with a network of igneous rocks. The principal veins are the Red Wing, Oro Plata, Blue Wing, North Branch of Blue Wing, two Pay Rock veins, and the White Wing.

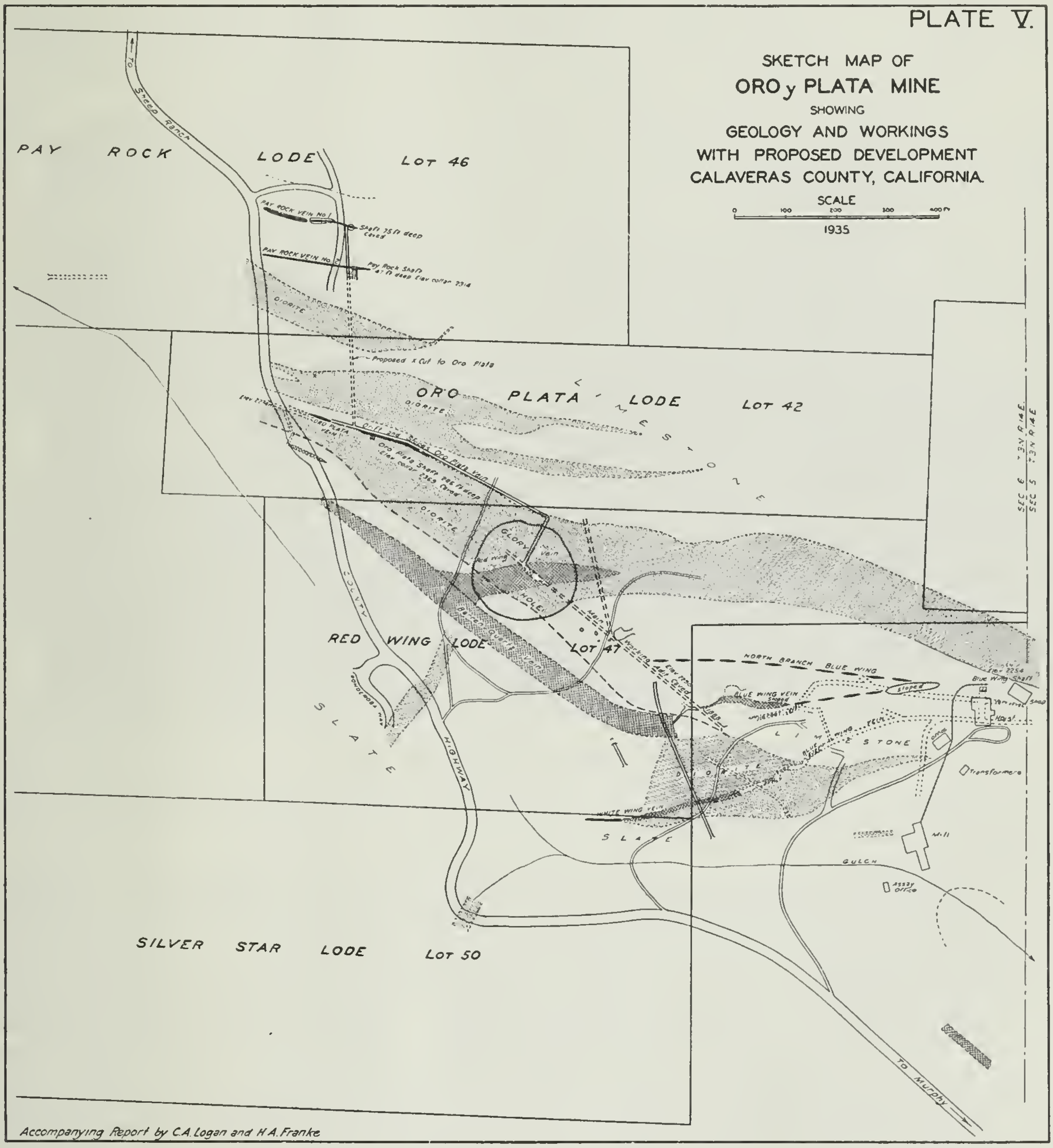


PLATE V.

SKETCH MAP OF
ORO y PLATA MINE
SHOWING
GEOLOGY AND WORKINGS
WITH PROPOSED DEVELOPMENT
CALAVERAS COUNTY, CALIFORNIA.
SCALE
1935

Accompanying Report by C.A. Logan and H.A. Franke

0
100
200
300
400 Ft
To Sheep Ranch
PAY ROCK LODE
LOT 46
PAY ROCK VEIN No. 1
Shaft 75 ft deep Caved
PAY ROCK VEIN No. 2
Pay Rock Shaft 47 ft deep Elev collar 2314
DIORITE
Proposed X Cut to Oro Plata
ORO PLATA LODE
LOT 42
LIMESTONE
ORO PLATA VEIN
Drift and Stopes Oro Plata Vein
Oro Plata Shaft 286 ft deep Elev collar 2369 Caved
DIORITE
GLORY HOLE
Red Wing
Vein
COUNTY
RED WING LODE
LOT 47
SLATE
HIGHWAY
NORTH BRANCH BLUE WING
BLUE WING VEIN
Stoped
Stoped
Elev 2254
Blue Wing Shaft
Hoist
Office
LIMESTONE
BLUE WING VEIN
DIORITE
WHITE WING VEIN
SLATE
Transformers
Mill
GULCH
Assay Office
SILVER STAR LODE
Lot 50
To Murphys
SEC 6 T3N R14E
SEC 5 T3N R14E

(1) The Red Wing vein, which strikes approximately N. 85° W. with a northward dip, is supposed to be a mineralized dike, which exceeds 100 ft. in width, and consists of lenses of quartz and igneous rocks interspersed with streaks of gouge.

(2) The Oro Plata vein, lying on the north side of the Red Wing, between dike rock and limestone, is thought to strike S. 85° E., dipping almost vertically. This vein was extensively mined from 1878 to 1881, and all workings are now caved and inaccessible.

(3) The Blue Wing vein lies on the south side and branches off of the Red Wing. Its walls are limestone. It strikes S. 75° W. and

dips 75° SE. This vein was worked from 1882 to 1886, and was reopened by the Union Consolidated Mining Company in 1926. The workings consist of a 317-ft. inclined shaft, with levels at 110 and 300 ft. The 110-ft. level is a drift along the vein 500 ft. long. Two ore shoots have been opened and mined, the east ore-shoot to the 110-ft. level, and the west ore-shoot to the 300-ft. level. A 45-ft. winze was sunk below the 300-ft. level on this latter ore-shoot, and part of the ore extracted. The east orebody is said to have been 8 to 10 ft. in width and 75 ft. in length, while the west orebody was 2½ ft. in width and 160 ft. in length. The ore consisted of a quartz gangue with free gold and tetrahedrite, averaging one ounce of gold a ton. A heavy flow of water (100 miner's inches) from a water channel was encountered on the 300-ft. level and operations were discontinued in 1932.

(4) A branch of the Blue Wing, known as the North Branch, intersects that vein immediately west of the Blue Wing shaft. It strikes N. 85° W., with a vertical or slightly northeast dip. It parallels the Red Wing vein. Very little prospecting has been done on this vein, but a very narrow body of ore is known to occur along it. This vein, as well as the Red Wing vein, will be intersected by the new adit which is being driven.

(5) The two parallel Pay Rock veins occur in the limestone north of the Red Wing. They strike N. 78° W. and dip southwest. Very little work has been done on either. A 75-ft. vertical shaft was sunk on the north vein in 1880. It is claimed to be 2 ft. in width. A 47-ft. inclined shaft was sunk on the south vein in 1914, which exposed a vein from a narrow streak to a maximum width of 26 inches. The ore averaged 1.10 ounces of gold a ton.

(6) The White Wing vein lies south of the Blue Wing, striking N. 85° W. and dipping 54° NE. The new 325-ft. adit intersected this vein at 152 ft., at which point the vein is 20 ft. wide, 11½ ft. of which is milling ore, averaging 0.25 ounce a ton. Both of its walls are dike rock.

From 1878 to 1881 the Oro Plata vein was extensively worked from the 286-ft. shaft, with levels at 110 and 200 ft. All ore above the 110-ft. level is said to have been mined, but the ore between the 110- and 200-ft. levels was developed but not mined because it could not be treated in the chlorination plant. From 1886 to 1887 the Red Wing vein was mined by the glory-hole method, milling as much as 300 tons of ore daily. Some development was also done on the Pay Rock and Blue Wing veins. All ore above the 110-ft. level of the Blue Wing vein was mined and milled. The milling system was changed to amalgamation and concentration, but operations were closed down in 1888, due to difficulties in treating the ore. A portion of the ore mined at that time is said to have been low-grade, and the recovery was only 50 to 60%.

Scoles states that the ore on the north side of the hill, Pay Rock and Oro Plata veins, consists mainly of galena, with a silver-gold ratio of 6 to 1; while the ore from the south side of the hill, the Blue Wing veins, has tetrahedrite, with no galena, and a silver-gold ratio of 1 to 1. Occasional bunches of stibnite have also been observed, carrying small values in gold and silver. F. B. Morse, in Report VI of the State

Mineralogist, mentions the transition in the Red Wing vein, the ore on the south side as being tetrahedrite, while north side ore contained galena and zinc blende.

The property is now equipped with a 60-ton flotation mill, built in 1929, and first operated in July of that year. There is a Hendy 3-ft. by 4-ft. primary ball-mill, Hendy 5-ft. by 10-ft. secondary ball-mill, Dorr classifier, and Kraut flotation cells. The mill was last run in the spring of 1935 in making a test. Other equipment includes a Hendry-Bolthoff electric hoist, 360-cu. ft. Ingersoll-Rand compressor and a 160-cu. ft. Chicago-Pneumatic portable compressor. All equipment is driven by electric motors. Five men are now employed.

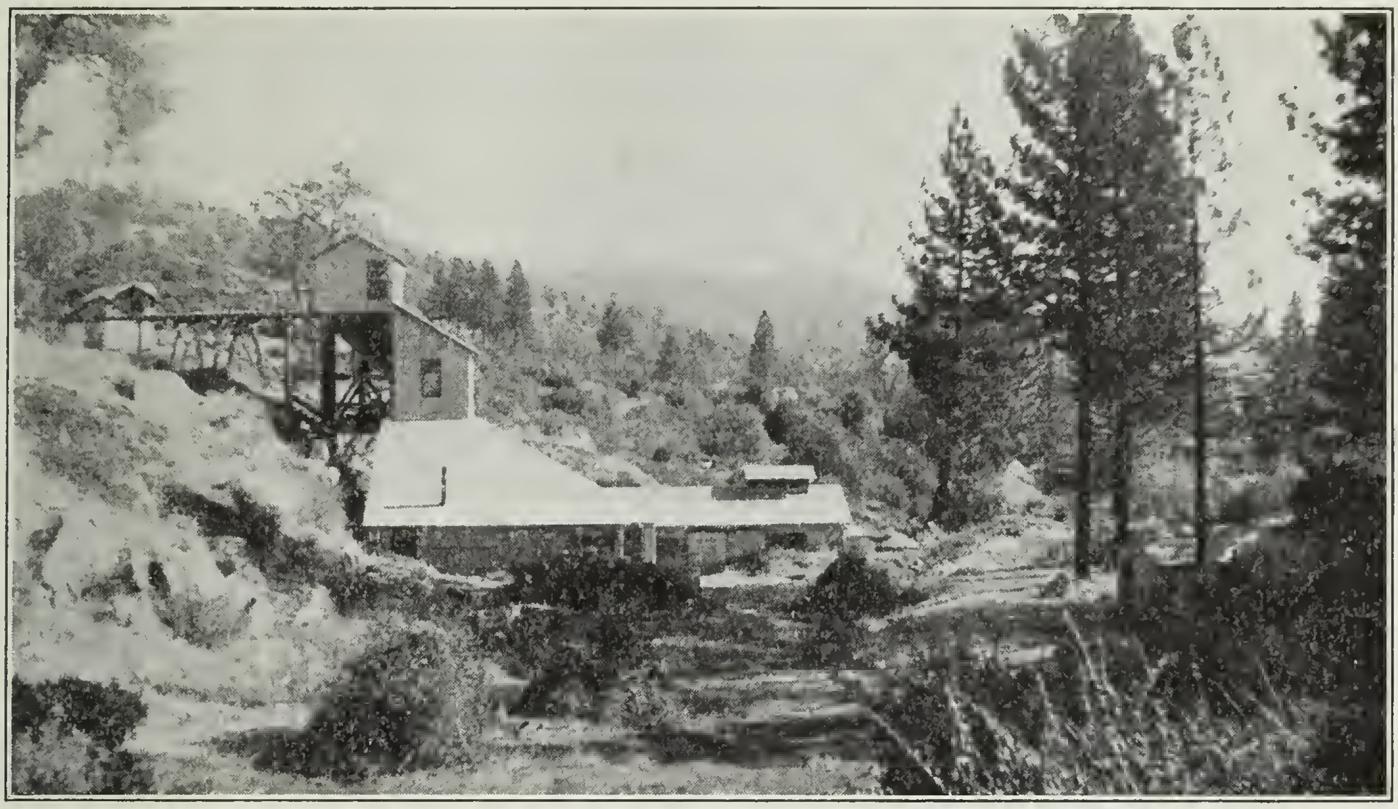


FIG. 9. Mill at the Oro y Plata Mine.

Patsy Bob Mine (*Rio Vista*), patented, is located about 1½ miles southwest of Melones, on the west slope of Stanislaus River. It is reached by automobile for one mile via the old Sierra Railway grade, the tracks of which were removed some time ago, thence trail for ½-mile. The property is owned by the *Rio Vista Mining Co.,* Sonora, for which J. C. and A. D. Duchow, Sonora, are trustees. Norman S. Naughten and Eugene F. Casenave, Melones, have worked the property under option and lease intermittently for the past 4 years.

There is a series of small parallel quartz veins, from ⅛-inch to 2 ft. wide, and from 6 inches to 8 ft. apart, over a total width of 240 ft. The vein formation trends northeast and dips southwest. The porphyry dike intrusion on the footwall apparently accounts for the enrichment. The hanging wall is said to be slate, with some andalusite. The mineralized zone is fairly well faulted. The ore carries mainly pyrite, chalcopyrite, arsenopyrite, galena, some free gold, and tellurides. Development includes an open cut 450 ft. long, and a 100-ft. tunnel running eastward. Other open cuts, tunnels and shallow shafts have now caved in.

Five men were working when the property was visited in November, 1935. They had started to mill some of the ore that had been mined during the past four years. The ore is hand shoveled down a steep 180-ft. ore chute to a 40-ton ore bin, where it is fed to a 2-stamp Birch mill, driven by a gasoline engine. An amalgamation plate and traps are used to recover the values. Two pumps are used to pump water to the mill from the Stanislaus River. Assays across the entire 240-ft. width of the ore zone are said to average $13.50 per ton, but field pannings and screenings are said to only average $7.25 per ton.

Pearline Quartz Prospect, consisting of 4½ acres, adjoins the Benson mine to the northwest, 2½ miles west of Altaville. The owners, Bob Hall and L. K. Austin of Altaville, were prospecting the property when visited. There are three veins, from 6 inches to 2 ft. in width, striking northwest and dipping east. The values are in free gold and sulphides. Development consists of a 25- and a 50-ft. vertical shaft, worked by means of a windlass. An old 50-ft. crosscut tunnel driven northward was never completed. Hand tools are used.

Pioneer Mine, about 6 miles southwest of Copperopolis, is owned by the Jackson D. McCarty Estate, Copperopolis. G. P. Copp of Copperopolis leased the property in 1933, since which time two men have been prospecting it at intervals. The 3-ft. quartz vein strikes north and dips east. The ore, containing free gold and 5% sulphides, is said to assay $6 a ton in gold and silver. Development includes a 160-ft. tunnel and two shafts, each about 60 ft. deep. There is a Gardner air compressor driven by a gasoline engine.

Poe Quartz Mine, ¼ mile west of Railroad Flat, is owned by Edgar Poe and Morris Taylor of Railroad Flat. G. H. Buyck cleaned out the 90-ft. shaft and a drift 50 ft. northward, in the summer of 1934, but did not operate the mine. A 2-ft. quartz vein is said to strike north and dip east. Another 5-ft. vein is undeveloped. The ore contains pyrite, galena, and some free gold.

Poorman (Rand) Mine is owned by Mrs. Sarah Klem (? Klein), Philadelphia, Pa. The vein, 3 ft. in width, strikes due north and dips 65° W. Porphyry dike rock is on both walls of the vein. The country rock is Calaveras slate. Old workings consist of a 312-ft. inclined shaft along dip of vein (now caved), with levels at 160 and 250 ft. The old tailings from this property have been located by Ed. King as the *Liberty Bell No. 3 Claim,* and are to be reworked.

Dave Porteous Mine, northeast of West Point, is being prospected by Messrs. Beard and Whitaker. Three men are employed.

Ranch Mine, also known as *Sherman Ranch, New York-Calaveras Mine,* situated 9 miles by road northwest of Copperopolis, is owned by the Jackson D. McCarthy Estate, Copperopolis. The property was leased for four years, starting about 1928, by Bill Anderson and associates. They are said to have recovered $16,000 from the blanket vein worked through a 225-ft inclined shaft, which is situated about ¼ mile north of the principal Ranch mine shaft. A 40-ton jaw crusher, ball mill, two Frue vanners, a 25-h.p. diesel engine, and a hoist driven by a 12-h.p. gasoline engine, used by these operators, still remains on the property. H. Hartley, La Crosse, Wisconsin, and associates leased the Ranch mine and commenced working about January, 1935, employing several men. Their operation had stopped prior to the writer's visit in December, 1935, although the mine was being kept unwatered. They are said to have treated 140 tons, averaging about $4 a ton, at the Royal mill.

The Ranch mine shaft is 235 ft. deep on a 29° incline, and has levels at 100 and 200 ft. The flat vein, which strikes north and dips 29° E., has been developed by a 400-ft. drift north on the 100-ft. level and a 200-ft. drift south on the 200-ft. level. The 400-ft. drift connects with the workings of the 225-ft. shaft mentioned in the first paragraph above. The vein varies from 5½ to 8 ft. in width on the 100-ft. level and from 12 to 18 ft. in width on the 200-ft. level. The quartz ledge is stratified with slate and quartzite. The ore is mainly free-milling above the 100-ft. level, but consists largely of sulphides on the 200-ft. level. The country rocks are slate and greenstone. Equipment at the ranch shaft consists of a hoist and a 250-cu. ft. Ingersoll-Rand compressor, both driven by gasoline engines.

Rathgeb Mine, 3 miles southeast of San Andreas, is owned by Frances B. Reed, San Andreas. It is northeast of the Union Cordova mine. The vein is said to be on the contact of black clay slates and amphibolite schist, striking north and dipping 70° E. Old workings include a 220-ft. shaft, with short drifts on the 120- and 200-ft. levels. The owner of the nearby Union Cordova mine states that T. A. Rickard's descriptive excerpt given on page 147 of our Bulletin 108, under Rathgeb mine, really applies to the Union Cordova mine.

Red Top Prospect, or *Ma-Ka Lac-A Rose,* comprises about 125 acres along Tupper Creek, in the northern part of T. 3 N., R. 14 E., about 5 miles northeast of Murphys, via Adams Ranch. S. B. Gardner, Murphys, the present owner, has operated the property at intervals since February, 1934. *Red Top Mine, Inc.,* worked the mine a short time in 1924. Different portions of the ground had originally been located by Joaquin Leonard and George S. Taylor of Murphys.

The present owner does not believe the main vein has yet been developed, and that the present developed orebody is an off-shoot from the main ledge. This ore-shoot strikes northwest and dips 47° SW. It is from 6 inches to 5 ft. in width, and has been developed about 130 ft. The country rock is slate and slaty schist. Development includes a 67-ft. inclined shaft on the vein, with levels at 29 and 47 ft. A drift has been driven 70 ft. southeastward on the 29-ft. level; also a 60-ft. drift northwest and 200 ft. southeast has been run on the 47-ft. level. The ore contains free gold and pyrite, and is said to average $25.00 a ton.

Three different veins are said to traverse the three *Tupper Creek claims* on the property. A 150-ft. tunnel has been driven on No. 1 claim, a vein striking north has been uncovered 20 ft. on No. 2 claim, and two open cuts dug on No. 3 claim.

Milling equipment consists of a 4 by 6-in. Straub jaw crusher, a 12-ton Straub ball mill, amalgamation plate, and a Straub-Overstrom concentrating table. There is an electric Westinghouse hoist and a 160-cu. ft. Gardner-Rix compressor driven by a 30-h.p. motor. Two men are employed.

Rich Gulch Mines comprise 134 acres under agricultural patent and two unpatented claims covering 3000 ft. in length, called Sparrowhawk and Alert claims; about six miles from Mokelumne Hill. Elevation, 2000 ft. John C. Jens, owner, R. F. D. 1, Box 11, Mokelumne Hill.

A series of veins, claimed to number seven in all, strike N. 70° E., extending from the adjoining Ilex property into the NE$\frac{1}{4}$ of the NW$\frac{1}{4}$ of Sec. 2 and possibly farther. This series is reported to be cut by a vein striking N. 22° E. which, on the Sparrowhawk claim, has a width of 2 ft. and is claimed to be traceable for 3000 ft. Jens reports that two pockets (the largest of several found) were taken out of the 'Iowa Mine' portion of property in NE$\frac{1}{4}$ of NW$\frac{1}{4}$ of Sec. 2, which yielded $4,000.

This work was on the so-called South Tiger vein, where an adit 700 ft. long was run, with some drifting and a raise 65 ft. long. The country rock is mica schist of the Calaveras (Carboniferous) formation. A depth of 200 ft. is said to have been reached. About five miner's inches of water issue from this adit.

The Laidet adit and drift on the unpatented claims is reported 200 ft. long but has not yet reached the vein from which some good ore was taken in a shaft 60 ft. deep. A deep adit could be run from the Calaveras River to crosscut all the veins.

There is no equipment on the property.

Rindge Properties. Frederick H. Rindge (last address, 439 N. El Dorado Street, Stockton) spent several years mining and prospecting in the vicinity of Glencoe and Jesus Maria. The old *Noce Placer Mine* on Whiskey Slide Hill was first operated by hydraulicking. From placer mining he turned to quartz mining, developing three neighboring properties, which are briefly described below. The information given is all second-hand. All of the Rindge operations in Calaveras County, upon which considerable money was spent, ceased about 1928 or 1929, and no further work had been done on the properties when the county was visited in December, 1935.

Rindge No. 1, located in Sec. 12, T. 5 N., R. 12 E., was developed by a 740-ft. vertical double-compartment shaft. A total of several thousand feet of crosscuts were driven from the 200-, 400- and 500-ft. levels. The best ore is said to have been found on the 700-ft. level. It is said that about 2000 tons of ore, running about $2.50 a ton, was milled at the plant on Rindge No. 3. Machinery on this property was attached by Gladding McBean and Co., who turned it over to the U. S. Machinery Company in Sacramento for sale.

Rindge No. 2 was said to have comprised 33 claims, mainly located in Secs. 11, 12, 13, 14, 22 and 23, same township, about 8 miles southeast of Mokelumne Hill, north and west of Wet Gulch reservoir. Five quartz veins are said to traverse this property, the main ones being known as the Whiskey Slide, 4 to 8 ft. wide, and the Big French vein. The Whiskey Slide strikes northwest, and dips to the east. Development consisted of a 6000 or 7300-ft. tunnel, driven northeastward. However, no ore is reported to have been developed from this operation. A 677-cu. ft. Ingersoll-Rand compressor driven by a 100-h.p. electric motor and miscellaneous equipment remain on the property. The property is now said to be claimed by the *Prosperity Mining Corporation,* of which Add Kramer, 458 S. Spring Street, Los Angeles, is the principal.

The *Schoolhouse Mine,* in Sec. 11, is said to have been one of the properties included, adjoining the above group. Its development includes a 170-ft. inclined (78°) shaft and a 90-ft. inclined shaft (caved). More than 300 ft. of drifting on the vein is said to have been done on the 150-ft. level of the 170-ft. shaft. A 5-stamp mill remains on the property.

Rindge No. 3, or True Blue Mine, comprising 160 acres of patented land, southeast of the old town of Glencoe, is owned by Baptiste Mandana, Mokelumne Hill. The inclined shaft is said to be 280 ft. deep, with levels at 100 and 140 ft., from which some work was done. The main vein is said to average 4 ft. in width. This quartz vein is said to have been badly broken, and that, as well as an abundance of water, made operations difficult. The footwall and hanging wall are both slate. One source states that $16,000 was produced, mainly from one rich ore shoot. A 10-stamp mill, amalgamation plates, and two concentrating tables remain on the property. Other equipment was sold at sheriff's sale.

M. C. Haley has a one-stamp mill and amalgamation plate one-half mile southeast of West Point, where ore from different properties is milled at intervals. Ore from the *Claude Smith* property and the *Rough and Ready Mine* were milled in the spring of 1935.

Royal Mine, formerly *Pine Log,* embracing the Royal Lode, Pine Log, Emma, Goodenough, Ant Hill, Railsplitter Quartz, Royal Mine Extension, Railsplitter Lode claims, and Pine Log millsite, is now owned by Frank S. Tower, Milton. The property is in the Salt Spring Valley at Hodson, 3 miles northwest of Copperopolis.

The mine was operated extensively from 1895 to 1905, then closed down until 1914, when a little work was done. It was idle from 1916 until January, 1919, at which time the *Texas-California Mining Company,* a Boston corporation, commenced to work the property. Over three years were spent in unwatering the mine, and small tonnages of ore were milled from development. The property was operated off and on until 1929, when the *Western Empire Mining Company* developed the mine through 1930, commencing to mill ore in January, 1931, but stopping in August, 1931. Substantial development was done in 1931, including the deepening of main shaft 125 ft., and considerable drifting and crosscutting from the bottom of the shaft, then over 1000 ft. deep. The mine lay dormant from August, 1931, until January, 1932, when Frank S. Tower resumed operations, which have continued to date. For the past several years prolonged state and county tax litigation, as well as some legal entanglements, have kept down the progress of the mine. This difficulty was settled the latter part of 1935, when a compromise agreement was reached between the present owner and the state and county.

The main Royal vein, striking N. 50° W. and dipping 30° NE., has numerous overlying and cross veins. The quartz occurs in a series of large lenses in a dike of diabase. The quartz of the fissure vein often has seams of calcite running through it. The diabase wall-rock, which is often mineralized, is mined and milled along with the quartz. The hanging wall is slate and the footwall is diabase. About 60% of the gold is free, and the remainder is associated with pyrite, galena and sphalerite (black-jack).

Development includes a 1200-ft. shaft, inclined from 25° to 35°. A level has been run every 100 ft. In 1930 a 1000-ft. drift was driven southward on a vertical section of vein from the 700-ft. level. Much of the ground between the 700 and 1200-ft. levels was worked out by 1905. During the past four years, however, considerable stoping has been done between the 1000 and 1200-ft. levels. The vein averages 16 ft. in width on these levels, dipping about 45° NE. Stopes have 80 ft of backs. On the 1200-ft. level the main drift is westward on the Royal vein for a distance of about 600 ft. Room and pillar mining methods are used.

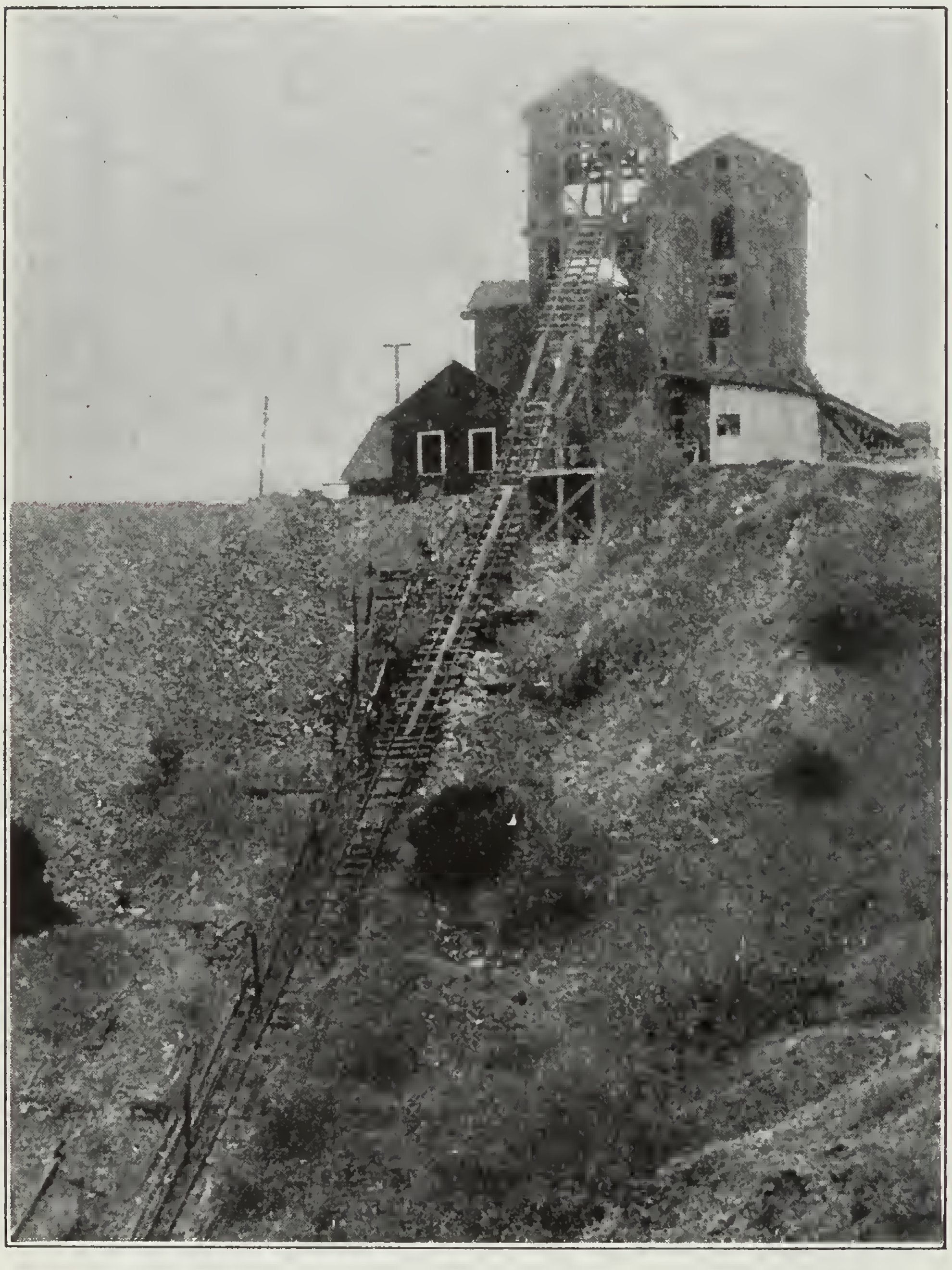


Fig. 10. Inclined shaft and crushing plant at Royal Mine.

Recent development includes the installation of a small electric hoist and headframe on the 125-ft. Goodenough shaft, 300 ft. southeast of the main shaft. After retimbering, drifts are to be driven east and west from the bottom of this shaft, connecting with the main workings of the Royal mine so that ore may be dropped down the stopes and hoisted through the main Royal shaft. Ore may later be hoisted from the Goodenough shaft.

The ore is hoisted in a $3\frac{1}{2}$-ton skip from mine to crushing plant, where it is broken in a Gates gyratory crusher. From the bins the ore is trammed 800 ft. to the mill by an electric locomotive in two 5-ton cars. An electric hoist at the mill lifts the ore by 2-ton skip to the 250-ton mill bin. Only 20 of the 120 stamps (1200 pounds) in the mill are now operated. The pulp from stamps goes through No. 2 screens to $4\frac{1}{2}$ by 12-ft. amalgamation plates. The plate tailings then go to a 1-cell Southwestern flotation machine (used as a cleaner) and thence to two 6-ft. Frue vanners. The vanners are installed for the purpose of pulling off the coarser concentrates not raised by flotation and a small per cent of oxidized values. From 92% to 96% extraction is claimed with this process over a five-month period. Sixty-five tons of ore was being treated per 24 hours. The mill has run about half time for the past four years. Some custom-milling has been done.

Other equipment includes an electric hoist on the main shaft, belt-driven by a 50-h.p. General Electric motor; a 528 and a 196-cu. ft. Ingersoll-Rand compressor and a 356-cu. ft. Chicago Pneumatic compressor; and a Dean, Rumsey, Sterling, and two Triplex pumps. The mine makes about 90 gallons of water a minute. A total of 17 men were employed at the mine, not including about 8 lessees on the mineralized surface ground who work by means of small shafts, each with a windlass. The Royal mine had until recently been worked two shifts underground, but now there is only one shift. The mill has been run three shifts.

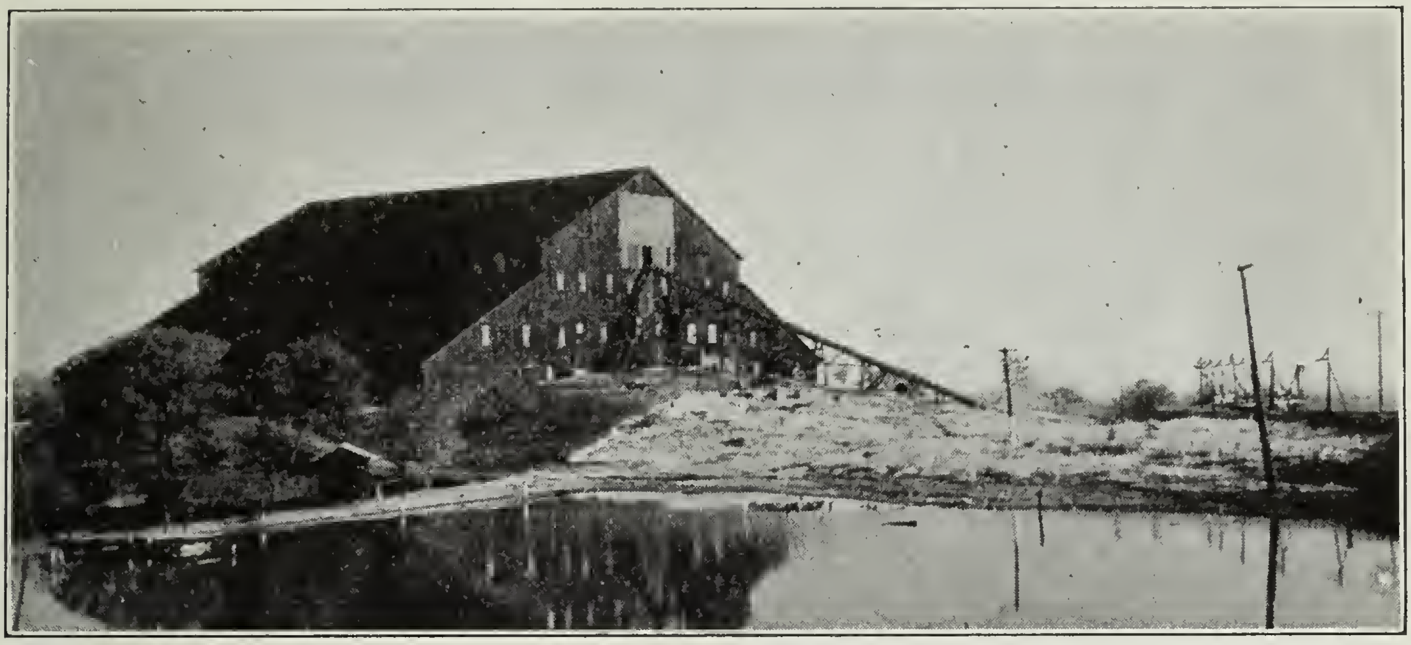


FIG. 11. Mill at Royal Mine. Lately, only 10 or 20 of the 120 stamps have been in operation. Electric tram line at right.

Sanderson Mine, in Sec. 35, T. 6 N., R. 13 E., 1 mile south of Railroad Flat, is owned by A. P. Stotts, R. F. D. No. 1, Box 35, Mokelumne Hill. George Buyck reopened and unwatered this old property in March, 1933. In August, 1933, he sold his interest to R. P. M. Davis and Harold Wheaton, 694 Subway Terminal Building, Los Angeles, who operated the mine until March, 1934. In July, 1935, the *K. and K. Mining Company* took it over. Vera L. Knox and Roy T. Kirkham, 429 N. Ogden Drive, Los Angeles, were associated with the latter concern, which discontinued operations the middle of November, 1935.

The ledge strikes northeast and dips 60° E. The vein material, from 8 inches to 3 ft. in width, consists of quartz and slate. The ore is heavy in sulphides. Ore shipments to the Selby and Salt Lake City smelters in 1933 and 1934 averaged from $70.00 to $140.00 a ton. The walls are Calaveras slate. Development includes a 400-ft. inclined (45°) shaft, with levels at 100, 200, 300 and 360 ft. Short drifts have been driven along the vein from each level. Most of this development work was done from 1871 to 1875. The recent operators confined their work mainly to high-grade ore on the 360-ft. level.

Equipment remaining on the property from the last operation includes a Parke and Lacy steam hoist, Gardner compressor, a Western Electric generator driven by a Beaver gasoline engine, a Buffalo blower driven by a General Electric motor, and a pump. There was no mill.

A total of 7 men had been employed by the K. and K. Mining Company, while the previous operators had as many as 20 men working.

St. Paul Mining Company owns the *Stand-by Mine* and millsite, and the *Fish* and *Dellinger* claims comprising about 24 acres, ¾ mile by road southeast of Railroad Flat. L. B. Fish, Railroad Flat, is president of the company. He worked the mine for a week in January, 1934, but sufficient capital could not be raised to continue development, and operations ceased. The quartz vein strikes north and dips 64° E. It varies from 3 inches to 3 ft. in width. Workings include a 70-ft. inclined shaft along vein, with a 400-ft. drift from the 65-ft. level. The small mill includes a 30 by 40-inch ball-mill, amalgamation plate, and Union Iron Works vanner. There is a gasoline-engine-driven hoist, cylinder pump and a compressor.

Shaw Mine, 3 miles north of Murphys, on ridge between San Domingo Creek and Sullivan Gulch, is owned by A. S. Shaw of Murphys. The 2-ft. vein has a footwall of serpentine and a hanging wall of slate. Old workings include a 145-ft. shaft and crosscut tunnel 245 ft. long connecting with the shaft.

Sheep Ranch Mine, formerly *Wallace & Ferguson Mine,* at Sheep Ranch, is owned by C. L. Feusier, 1067 Green Street, San Francisco. It has been the deepest and best prducer on the East Belt in Calaveras County. A production of $4,000,000 from 400,000 tons of ore mined is reported from the workings down to the 1300 level. The entire tonnage mined was not sent to the mill as there was a secondary sorting of the mined ore. The maximum width of the vein broken in mining above the 1300 level was about 5 ft. over a length of 1400 ft. Practically all values were in free gold. The quartz fissure-vein, 3 ft. or more in width, strikes N. 55° W. and dips 70° to 75° NE., in hard, black, siliceous mica-schist and in slate.

This property was discovered and worked in the early seventies, and was then known as the Wallace and Ferguson Mine. The property was sold to Haggin and Hearst about 1874, who operated it until 1893. The adjoining *Chevanne* and *Pioche* mines were also purchased and developed during this period. The mine was again worked from 1898 to 1907, during which time the present owner came into possession of the property. Some 43,150 tons of ore averaging $10.65 a ton was milled, most of which came from the 1300 and 1400 levels and some from the 1000 level. The mine was idle from 1907 to October 19, 1917, when the *Golden Gate Exploration Company* began unwatering the workings. This company operated the property until June, 1922, since which time the mine has been closed down. A total of 30,832 tons of ore from all available sources in the mine, averaging by assay $11.93 a ton, was milled during this last operation. Practically all of this ore came from the 1500 and 1700 levels, with smaller amounts from the 1000 and 1400 levels. The bzottom or 1700-ft. level is said to have had as good a showing of ore when the last operations ceased as any of the upper levels, and the owner has confidence in the downward continuance of the ore shoot. The last operation is said to have ceased because of the post-war period, when scarce and inefficient labor was unable to provide the mill with its capacity of ore.

The last operation of this property is well described on pages 158–159 of Report XXI of the State Mineralogist.

Shenandoah Mine, comprising the *Way, Hoosier* and *Mary Lory* claims, is 5 miles northwest of Mountain Ranch, on Jesus Maria Creek. J. F. Vassar of Valley Springs and associates have recently leased this old property from J. S. Jack, San Andreas, Mazzini Gattavara and others of Jesus Maria, owners. According to Report XIV of the State Mineralogist, the country rock is a hydro-mica schist and quartzite, east of which is an area of amphibolite schist and diorite; these rocks striking northwest. The system of fissures in the old lower workings strike N. 20° E. and dip 60° W. The white quartz vein is from 2 to 5 ft. in width. The report states that the central portion of the vein, which extends over two spurs of the main ridge, has, by weight of the mountain, been bent over to the east giving the vein a dip of 75° E., with a strike of N. 70° E. The torsion of the rocks has resulted in the faulting of the vein 40 ft. to the northwest. The old workings include several old tunnels ranging up to 1630 ft. in length, and a 500-ft. shaft. An old 10-stamp mill remains on the property.

Sonoma Mine, 4 miles north of Murphys, was recently prospected. Old workings consist of a 10- and a 125-ft. shaft. Now idle. It is owned by F. Hewlett and others, c/o Mrs. Cora Blackden, 3623 Sacramento Blvd., Sacramento.

Spotted Pup Claim, in Sec. 22, T. 5 N., R. 12 E., was located by Ed King, San Andreas, in January, 1935. It was recently leased to Cartte Wood and George Jones, who had four men prospecting the claim in May, 1936. The vein is a continuation of the Doodlebug vein, striking northeast and dipping northwest. It is about 10 ft. in width, and has been developed by a 100-ft. adit. A rich pocket is said to have been taken out near the surface by the locator.

Steger and Josephine Claims, in Sec. 5, T. 6 N., R. 13 E., are 3 miles west of West Point. The Steger quartz vein, from 1 to 4 ft. wide, strikes N. 12° W. and dips 65° W. The ore is rich in sulphides. There is a 450-ft. tunnel, mainly on the vein. There are also two old shafts, 130 and 150 ft. deep. The formation is granodiorite. The Josephine has a 35-ft. vertical shaft and a 60-ft. drift. A 3-stamp mill is on the property. Charles E. Stewart, 1132 S. Lincoln Street, Stockton, is developing the mine. Allen Smith and Mrs. Katy Phillips of West Point own the property.

Stonewall Mine, 3 miles south of Murphys, is owned by George S. Taylor, Murphys. Two crosscut tunnels, 300 and 620 ft. long, tap the vein, which has been drifted on a total distance of 200 ft. There is also an old 85-ft. shaft. Idle.

Swiss, or United Mine, 4 miles east of Railroad Flat, adjoins the Fine Gold mine. The 5-ft. vein strikes north and dips 73° W. Old development includes a 204-ft. shaft and a 1200-ft. tunnel. The property has long been idle, although it was prospected in the summer of 1935 by Victor G. Newbell. Theo. Madson, 2118 Hearst Ave., Berkeley, owner.

Tandee, H. H., Property, 1 mile north of Sheep Ranch, on O'Neil's Creek, is being prospected by D. T. Jones. Development includes open cuts on vein material thought to be an extension from the Sheep Ranch mine.

Tate Mine, in Sec. 10, T. 5 N., R. 13 E., about 4 miles southwest of Railroad Flat, on south slope of Esperanza Creek, was reopened by J. A. Darby, Murphys, and Sanchez Brothers, in 1932. A. H. Kent and C. Wood, 36 Locust Avenue, Long Beach, continued these operations for one year, but the mine was closed down the latter part of 1934. There is said to be a 12-ft. ledge, striking north. It carries base ore. Workings include a 150-ft. shaft, with levels at 50, 100, and 130 and 140 ft. The length of drifts all driven south, are: 30 ft. on the 50-ft. and on the 100-ft. levels, 40 ft. on the 130-ft. level, and 70 ft. on the 150-ft. level. A 4-stamp mill and two flotation cells remain on the property. Mrs. John Tate, Lodi, and Lee Sanchez, Hornitos, are the owners.

Telluride Group, consisting of two unpatented claims, 3 miles north of Murphys, adjoins the Independence mine, and has not been worked for four years. Workings include a 30-ft. shaft and a 100-ft. tunnel. Mrs. Minnie Hengen, San Andreas, is the owner.

Texas Mine, consisting of the Edna, Viola, Campo Seco, Alameda and Texas claims, in Sec. 11, T. 4 N., R. 10 E., about three miles northwest of Valley Springs, is owned by J. R. Hoskinson and Wm. T. Blalock, 810 N. Linden Drive, Beverly Hills. F. E. Ollinger and associates, lessees, had just subleased the property to J. F. Vassar, Box 26, Valley Springs, when visited in December, 1935, who contemplates erecting a 5-ton pilot mill, using a jaw crusher, ball mill, classifier and concentrating table. The quartz stringer zone consisting of 22 small veins, from 2 to 18 inches wide, strikes N. 50° W. and dips eastward. Development includes an old 85-ft. shaft and about 1500 ft. of tunnel workings.

Thompson, J. H., Ranch, about 3 miles south of West Point, has a small plant for the working of tailing of the old A. M. Harris Custom mill, operated from the 1860's to 1883. The plant, consisting of a Herman ball-mill and two Economy classifiers, driven by gasoline engines, is owned by Dr. Arthur J. Maurer, Franklin Bldg., Oakland. The plant was operated for a short time during the early part of 1935, and leased to a party early in 1936, who is now operating. About 700 tons of tailing, assaying better than $4 a ton, are said to remain on the property. The tailing is not of uniform texture and is difficult to concentrate.

Tom Smith Mine, 1 mile northwest of Sheep Ranch, on ridge between San Antonio and O'Neil's creeks, is owned by Chas. P. Snyder, San Andreas. The vein, 18 inches in width, strikes N. 56° W. and dips 45° NE. Old workings on the vein consist of a 400- and an 800-ft. tunnel. Idle for many years.

Total Wreck Mine, 1 mile northwest of Murphys, is owned by Chas. P. Snyder, San Andreas. A partnership consisting of Walter Heidrick, Fred Zurcher, Garver Martin, and John Richmond, of Murphys, recently leased the mine and cleaned out the old 150-ft. vertical shaft to a depth of 110 ft. A drift has been driven on the vein a distance of 30 ft. westward and 15 ft. eastward. The vein is said to be from 4 to 5 ft. in width, and has an almost vertical dip. The ore is said to average $6 in free gold and $2 in sulphides, the latter consisting of pyrite and galena. The ore is treated in the 5-stamp *Fairplay Mill.* Equipment includes a hoist and air compressor driven by gasoline engines.

Tucker, Sugar Pine and *Valentine* Quartz Claims, one mile east of West Point, are owned by A. I. and F. D. Garbarini of Jackson. The property was last worked in 1934. Development includes a 470-ft. tunnel.

Tullock, or Brown Mine, 2½ miles south of Angels Camp, is owned by the James Tullock Estate, Mrs. Lillie Bisbie, and Mrs. Emma Sell, Sonora. Domingo Rolleri, Angels Camp, who holds an option on the property, has subleased it to Norman Gilkey and C. R. Watkins, 330¾ N. Rampart, Los Angeles. They are now said to be organizing a company in order to obtain finances to work the mine.

It is on an east branch of the Mother Lode, and past production is reported to have come principally from small tonnages crushed at irregular intervals, and from pockets. The quartz vein strikes N. 50° W. and dips 45° NE. Both walls are slate. The ore carries more galena and silver than is usual for the Lode. Development includes an 800-ft. inclined shaft, which partly caved in from the heavy rains early in 1936.

Twin Oaks, or Bumstead Mine, about 4 miles northeast of Murphys, is owned by the *Twin Oaks Mining Company,* 1823 Van Ness Avenue, Fresno; R. P. Griffenhagen, president, and R. H. Griffenhagen, mine superintendent. There are four claims, the Twin Oaks, Gold Dollar, Big Four, and Iron Oak. The vein is from 1 to 4 ft. in width, and strikes slightly east of north and dips southwest. The sulphides and free gold are found in both the quartz vein and adjoining slate wall-rock. The ore is said to assay about $9 in gold, with a little silver. Workings include a 150-ft. tunnel connected by a 90-ft. shaft. The vein has been drifted on for 45 ft. from tunnel. When visited in November, 1935, a small Nenzel quartz mill was being installed. Other mill equipment will include a jaw rock crusher, Nenzel amalgamator, and a Wilfley concentrating table, all to be driven by a 4-cylinder Dodge motor.

Two Star Claims, in the Washington mining district, near the Independence mine, are owned by George S. Taylor, Murphys. Idle.

Union Cordova Mine, situated on the Guttinger Ranch, 3 miles southeast of San Andreas, is owned by Albert Guttinger, San Andreas. The Union vein strikes N. 30° W. and dips 70° NE. The vein material consists of quartz and considerable calcite. The country rock is amphibolite schist. The old workings include a two-compartment 455-ft. inclined (72°) shaft, with levels at 120, 160, 220, 350 and 430 ft. Guttinger informed the writer that the main development consists of the following drifts: on 120-ft. level, 300 ft. north and 120 ft. south; on 160-ft. level, 60 ft. west; on 220-ft. level, 200 ft. north and 50 ft. south; on 430-ft. level, 30 ft. north and a 30 ft. crosscut west to footwall. The ledge matter, consisting of quartz and schist, is said to be 30 ft. in width on the 120-ft. level, and widens out with depth. The old Union shaft is believed to be caved only as far as the 120-ft. level.

There are three other old shafts on the property, called the Illich, Chilean and Cyclone.

The Union Cordova mine was first worked by Rathgeb Brothers from the late 60's until the property was sold to the *Union Gold Company, Ltd.,* of London. A 30-stamp mill was then put in operation. Guttinger claims that T. A. Rickard's description of the recovery of a large pocket of gold, quoted on page 147 of our Bulletin 108, applies to the Union Cordova rather than the Rathgeb mine. The London firm operated the mine from the latter part of 1886 until the early part of 1888, when they moved operations over to the nearby Rathgeb Mine, which they worked at intervals until 1891. The Union Cordova was idle until 1894, when it was prospected by the Guttingers. It was bonded to the *California Exploration Company* in 1896, but this firm did all of their work on the Burgess Mine, a short distance southeast of the Union Cordova.

California Mother Lode Gold Mines, Inc., Industrial Trust Bldg., Wilmington, Delaware, commenced to work the Union Cordova in 1933. Officers of this company were Roscoe N. Smith, president and general manager; Dr. M. J. Dobson, vice president; Miss Ethel Hester, secretary-treasurer; and Ed. A. Bischoff, organization manager. They cleaned out the old shaft for 38 ft. and erected a headframe, when they abandoned operations because of a lack of finances. William W. Thayer, 1352 Van Ness Avenue, San Francisco, now has an option and lease on the property and expects to commence operations at an early date.

The *Burgess, Pedro, and Specimen* Claims nearby are also owned by Albert Guttinger. The Burgess vein strikes N. 55° W., and dips 65° NE. It is almost parallel to the Union vein, and is said to be about 5 ft. in width. Old workings include four shafts, two of which were 120 and 200 ft. in depth, but all are now partially caved. Guttinger's *Ambrosia* claim is in Lot 41 of Sec. 28, T. 4 N., R. 12 E., north of the Union Cordova mine.

Valentine, Mexican, Sierra King, Sierra Queen, and *Stoetzer Claims* are situated north of the old town of Glencoe. The *Richview* claim is in Sec. 30, south of the others. The old development on the Valentine property consists of a 350-ft. crosscut tunnel to the vein, which was drifted on for about 150 ft. east and west. The vein is about 75 ft. wide, but an assay of the ore showed most of it to be low grade. Some rich pockets are said to have been taken out of the mine in the early days. This mine was sampled by *Best and Belcher Mining Company,* 333 Kearny St., San Francisco, in the summer of 1935. There is said to be an old 1,800-ft. drift on the 3-ft. vein of the Mexican claim. All of these properties are owned by the *Haslett Warehouse Company,* trustees, 280 Battery Street, San Francisco.

Vista Mine, one-half mile south of Angels Camp, in Sec. 3, T. 2 N., R. 13 E., is being operated by *Russell Gold Mining Company,* Box 339, Santa Barbara; James A. Phelps, president, and J. W. Bandhauer, superintendent of operations. The property, consisting of 30 acres of patented agricultural land, is situated between the junction of Angels and Six Mile creeks, on ground formerly owned by Fred Prado. The present company began operations September 8, 1933.

Two principal veins are being developed, the Vista vein, which strikes east and dips 35° N., and a Mother Lode vein striking northwest, dipping 65° NE. Most of the ore thus far mined and milled has been from the Vista vein as development work on the Mother Lode vein has not yet come up to expectations. The Vista vein material is quartz and calcite. This vein averages 15 ft. in width. The footwall is greenstone and the hanging wall is slate.

The mine has a 350-ft. inclined (52°) $1\frac{1}{2}$-compartment shaft, with levels at 100, 200, and 300 ft. On the 100-ft. level a drift was run 50 ft. eastward; on the 200-ft. level there is a 300-ft. drift eastward and 200 ft. westward; and on the 300-ft. level a 200-ft. crosscut was run northward to the Vista vein. From the junction of the crosscut the Vista vein has been drifted on a distance of 300 ft. westward, and a 600-ft. drift has been driven eastward, partly on the vein. About 2500 tons of $7 ore are said to have been stoped and milled from this portion of the Vista vein. At the end of this 600-ft. drift, a 500-ft. crosscut was run northeastward to intersect the Mother Lode vein, finding ore that ran only $2 a ton. Development is now being continued alongside the Mother Lode vein to the northwest in hopes of intersecting a crossing and ore of better grade. The drift is being driven alongside the vein because it is easier to work in the amphibolite schist and slate wall-rock. The vein material consists of quartz, amphibolite schist, and calcite. Another drift has been driven slightly southeastward from the end of the 600-ft. drift toward the Vista vein and alongside the Mother Lode vein. One crosscut from this working to the Mother Lode vein showed a vein 16 ft. in width, averaging $4 a ton.

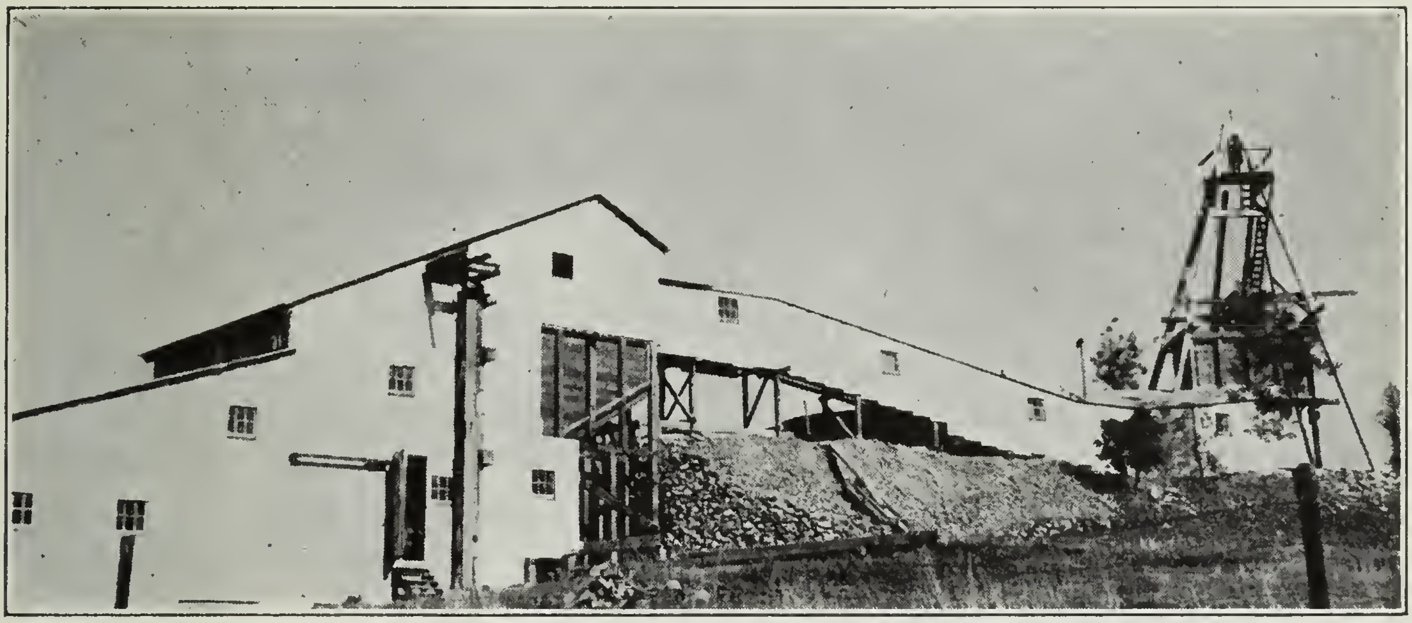


FIG. 12. Ten-stamp mill and headframe at Vista Mine, operated by the Russell Gold Mining Company.

Considerable stoping had been done on the eastern drifts from the 200- and 300-ft. levels, in November, 1935. On the 200-ft. level, 100 ft. east of shaft, the 15-ft. vein had been stoped for a distance of 40 ft. to a height of 100 ft., and 30 ft. farther there was a stope 60 ft. long and 60 ft. high. On the 300-ft. level there was a 60-ft. stope that was 30 ft. wide and 125 ft. high, and another 40 ft. long, 60 ft. high, and 15 ft. wide.

The property is equipped with a 10-stamp mill, two amalgamation plates, and a Deister plato concentrating table. Other equipment includes an electric hoist driven by a 22-h.p. General Electric motor, and a 225-cu. ft. Ingersoll-Rand compressor driven by a 40-h.p. General Electric motor. Milling commenced September 10, 1934. Only 5 stamps are used, milling 30 tons of ore daily. The ore is delivered to the mill by conveyor belt. The ore is said to average above $3 a ton. Eight men are employed at the mine, working one shift.

Only ore from the Mother Lode Central Mine was being milled in May, 1936, while development work was pursued in the Vista mine.

Washington (Bullion Hill) Mine, comprising five full claims and a fraction, 6 miles north of Murphys, just west of Sheep Ranch road, is owned by Mrs. Mary Jane Osselin, Sheep Ranch. The property was worked for two years, commencing in July, 1921, by the *Bullion Hill Mining Company*. Fraser and Hibbard of Los Angeles operated the mine at intervals from April, 1924, until 1926. Dr. J. M. Carr of Stockton, obtained a bond and lease on the property a few years ago. He commenced the present unwatering of the mine in 1934 by means of two centrifugal pumps connected in series, one set on the 400 and one on the 500-ft. level of the inclined shaft.

The workings include a 1250-ft. adit, called the 200 level which follows the vein N. 70° E. for 800 ft. The lens-shaped orebodies above this adit have been worked at places up to the surface. A 400-ft. inclined winze was sunk from this adit. The vein material is of solid quartz and ribbon rock, 3 to 6 ft. in width, which carries free gold and as high as 10% auriferous pyrite and galena, with reported traces of zinc, antimony, and manganese.

The 10-stamp mill last operated in 1926, is in need of repair. Other equipment includes two Wilfley concentrating tables, Ingersoll-Rand compressor, and an electric hoist. Two men are employed to keep the mine unwatered.

Whiskey Claim, about 3 miles southwest of West Point, is owned by J. H. Thompson, West Point. Two old shafts are 75 and 106 ft. deep. Ore taken from the bottom of the 106-ft. shaft in 1883 is said to have assayed $25 a ton. Assessment work is kept up on the claim.

Wolverine Mine, 4 miles northwest of Railroad Flat, is owned by Lillie and Maurice Taylor, Railroad Flat, et al. The quartz vein strikes N. 6° E. and dips west. It varies from 1 to 5 ft. in width. Development is said to include an old 400-ft. inclined shaft, with four levels. Some good ore is reported to have been found on the bottom level when a Mr. Smith of San Francisco last operated the mine for five months about 4 years ago. The operation ceased when the steam hoist equipment was destroyed by fire. A 10-stamp mill was erected during this period, but never operated, and it remains on the property. The mine is reputed to have been a rich producer in the nineties. The shaft is now full of water.

Woodhouse Mine is situated 4 miles southwest of West Point, on ridge between the Middle and South Forks of Mokelumne River. W. W. Gibson, 112 Market Street, San Francisco, owner, was the last one to work the mine. The operation commenced in October, 1934, and ceased in July, 1935. Previously, from June, 1933, to June, 1934, S. C. Mudgett and J. A. Flagg of Oakland had worked the property. A. J. Boerner, 812 Fulton Street, San Francisco, took over the mine late in June, 1936.

The Woodhouse vein, from 2 to 13 ft. wide, strikes north and dips 60° west. The ore is base, with some free gold. It is said to average $12.00 a ton. Both wall rocks are granodiorite. Workings include a 265-ft. (45°) inclined shaft, with levels at 90, 150 and 265 ft. The vein was drifted on for a distance of 300 ft. north on the 90-ft. level, a distance of 150 ft. south and 400 ft. north on the 150-ft. level and a distance of 200 ft. north on the 265 ft. level.

Mill equipment remaining on the property consists of three Gibson impact amalgamators, three Gibson table concentrators, and two 4 by 8 ft. apron plates. The former 50-ton Gibson rod-mill has been removed. There are also an electric hoist, Rix compressor, and a Worthington pump. The mine received electric power from its own hydro-electric plant, which includes a Pelton Water-wheel and a 150 K.W.-A.C. Westinghouse generator and exciter. A 2½-mile flume from the Middle Fork of Mokelumne River supplies the water. The total static head is 390 ft.

TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Abdellah	28	4 N.	12 E.	W. J. Johnston, San Andreas	15	
Acorn				George F. Summer, West Point		
Adelaide	24	2 N.	13 E.	Carson Hill Gold Mng. Co., % Lawrence Monte Verda, Angels Camp	15	R. XI, p. 169; XII, p. 89; XIII, p. 96; XIV, p. 66
Adelia	4, 5	2 N.	13 E.	Geo. C. Tryon Estate and Geo. M. Tryon, Angels Camp	19	
Adeline	33	3 N.	13 E.	Phil F. Pache, Altaville, and Julia P. Umberger, Angels Camp	10	
Aetna	17	6 N.	13 E.		20	R. XIV, p. 66
Afterthought				Ida Casey and J. P. Porter, Mokelumne Hill		
Alabama King				Clarence A. Berry, Valley Springs		
Aladdin Gold Mng. Co.						See Bright Star et a..
Alameda and Dalmazia Group	25, 26	4 N.	13 E.	Winnie P. Nuner, Wm. N. Nuner and George Braddock, San Andreas	60	R. XIII, p. 96
Alaska, Enterprise and Fredda	1, 12	6 N.	13 E.	F. P. Plageman, 354 Parnassus Ave., San Francisco	53	Field Report
Albany Flat	10	2 N.	13 E.	Domingo Rolleri, W. E. Gibbons, L. Oliviere, Geo. B. Bennett, G. Mazzio and Camellis Barsotti, % Geo. B. Bennett, Angeles Camp	9	
Alexander	31	6 N.	13 E.	W. P. Craig, % H. S. Crocker Co., 565 Market St., San Francisco	60	R. XIV, p. 68
Alhoa-Klondyke, Mammoth, Yaqui Camp and Seven Up Lodes	27	4 N.	12 E.	Desire J. Fricot, Angels Camp	83	
Alice I	6, 7	3 N.	11 E.	S. M., F. R., W. R. and F. L. Gregory, and Anna Inez Gall, 927 W. Magnolia St., Stockton	20	
Allen Thomas				David Eltringham and Mary E. Eltringham, Douglas Flat	20	
Alliance	1	6 N.	13 E.	Jos. F. Sterling, Arthur Wilson et al., % J. F. Sterling, 3455 Stanislaus St., Stockton		
Allison						See Garner Cons.
Allison-Merrimac Group	14, 15, 23	2 N.	13 E.	Jacob Allison, Jos. Allison Estate, Phillip F. Pache, % Eugene Allison, 1411 S. Hunter St., Stockton	60	R. XIII, p. 96
Alpha and Omega	20, 21	5 N.	13 E.		60	R. XIV, p. 68; Bull. 18, p. 123
Alpine	20	4 N.	13 E.		40	R. XIII, p. 96; XIV, p. 68
Altaville	29	3 N.	13 E.	Ed. R. Prince, F. R. Prince, Tessie R. Favinger et al., % Ed. R. Prince, Altaville		R. XIII, p. 97; XIV, p. 74
Alto	29	1 N.	13 E.		40	R. XIV, p. 68
Amador City				Jarvis Lloyd Estate and Rose T. Casey, San Andreas	20	
American Eagle	9	5 N.	13 E.		20	R. XIV, p. 68
Anna	33	3 N.	13 E.	John T. Fletcher and Rose Fletcher, Angels Camp et al.		

Anderson						See Table Mountain Ranch
Anderson Flat	18	6 N.	14 E.		160	Field Report
Angels	33	3 N.	13 E.	James V. Coleman, Jr., 148 Montgomery St., San Francisco		R. VI, pt. 2, p. 29; VIII, pp. 141-143; X, p. 150; XII, p. 89; XIII, p. 97; XIV, p. 68; XVII, p. 420; Bull. 108, pp. 127-128
Angels Camp Deep Mng. Co.						See Brown, Smythe & Ryland Cons.
Angora				John M. Shepherd, Murphys		
Anita				Burton Sperry, San Andreas		
Ant Hill						See Royal Consolidated
Apex	16, 17	4 N.	12 E.	Mrs. Ann Dower and Talton Hawes, % Talton Hawes, 1760 Page St., San Francisco	81	R. XIII, p. 104; XIV, pp. 79-80; XIX, p. 18; XX, pp. 4, 76; XXI, p. 144; Bull. 18, pp. 107-109; Bull. 108, pp. 139-140; U.S.G.S. P.P. 157, pp. 70-71
Ariel	5	5 N.	12 E.		12	R. XIV, p. 69
Arthur	6, 7	6 N.	14 E.		20	R. XIV, p. 69
Auction						See Texas
Bachman	10, 11	3 N.	12 E.	Kirby Development Corp., San Andreas	20	R. XIV, p. 69; XXI, p. 144; Bull. 108, p. 143
Bald Eagle	23	6 N.	13 E.	Jos. and John Enright, Mary A. Robinson, Enright Estate Co., et al., Suite 316, Bank of Italy Bldg., San Jose, or % John Jones, 1588 Liberty St., Santa Clara	21	
Bald Hill						See Bruner
Banner et al.	19, 20	6 N.	13 E.		25	R. XIII, p. 97; XIV, p. 69
Banner						See Mayflower
Baratini	15	5 N.	11 E.	Estate of David Cassinelli, San Andreas		
Barnyard	11	1 N.	12 E.	Gardner P. Copp and Lurie Drew Copp, % R. L. Gardner, 1246 Sacramento St., San Francisco	18	
Bartolo, Bartolo Annex, Excelsior	1, 2	6 N.	13 E.	Estate of Arthur Harrison, West Point	27	R. XIV, p. 69
Basco	33	4 N.	13 E.	John A. and Albert Dasso; Laura L. Faventa, 1000 54th Ave., Oakland; F. J. Solinsky and J. B. Reddick Estate, % F. J. Solinsky, Hobart Bldg., San Francisco	26	R. XIV, p. 70
Baumhogger						R. XIII, p. 97
Bear Mountain	29, 33	3 N.	12 E.	C. J. Tiscornia, San Andreas, and J. F. Tower, Milton	10	
Beatrice	1	3 N.	13 E.	J. J. Le Tournean, % F. P. Le Tournean, 3015 Branch St., Duluth, Minnesota		R. XII, p. 90; XIV, p. 70
Beckman						See Bachman
Beckley & Buckeye	20	3 N.	11 E.	Nellie McSorley, % Marie McSorley, 1778 Pleasant Valley Ave., Oakland; A. W. Bohall and Etta M. Bohall, % Leroy B. Thomas, American Trust Bldg., Berkeley		
Bee Tree				S. R. Danielson, Mokelumne Hill; and L. L. Rader, Glencoe		
Belcher						R. XIII, p. 97
Belle	23	2 N.	13 E.			R. XII, p. 90; XIII, p. 97
Bellevue				George Moeller and Louisa Moeller, Vallecito		
Bence; Tellurium & Minnie	34 35	4 N. 6 N.	13 E. 12 E.	Mrs. Minnie Hengen, San Andreas		R. XIII, p. 97; XXI, p. 145

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*To save space frequently only one of several names is shown in this column.

TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Bernardi						R. XVIII, p. 18
Bertha				George H. Chubey, R.F.D., Mokelumne Hill		
Big Ben	25	6 N.	13 E.	Thos. P. Lester, Railroad Flat, or R.F.D. 1, Mokelumne Hill		
Big Bonanza						See Oriole
Big Four	11	3 N.	12 E.		10	R. XIV, p. 70
Big Horn	30	4 N.	14 E.			R. XIII, pp. 97-98; XIV, p. 70
Big Horn No. 2	30, 32	4 N.	14 E.	Alma Lenore Francis, 702-3 Couch Bldg., Portland, Oregon	122	R. XIV, p. 70
Big Pine						See Easyz Bird
Big Seven	22, 27	2 N.	12 E.	P. Y. Lewis, Copperopolis	21	
Big Shot and Big Shot Ext.				F. L. Macpherson, % Domingo Rolleri, Angels		
Big Spring	3	2 N.	13 E.	Norman Smith, Thos. Cutler, Katherine Collins, et al., % Robt. P. Sloan, Vallecito	12	R. XIV, p. 70; Bull. 108, p. 128
Big & Little Sattellite	4	4 N.	10 E.	Penn Mining Co., % Chas. R. Enos, Midland Saving Bank Bldg., Suite 719, Denver, Colorado		R. IV, pp. 149-150; Bull. 18, p. 125
Big Tunnel						See Mammoth & Del Rey
Billings	33	3 N.	13 E.	James V. Coleman, Jr., 148 Montgomery St., San Francisco	2	See Angels Mine
Billy Williams	25, 26 36	7 N. 7 N.	13 E. 13 E.	Rowe Syndicate and Thos. H. Jenkins, 507 Neal St., Grass Valley or West Point	10	R. XIV, p. 70
Binum						R. XIII, p. 98
Birney & Golden Slipper	29, 30	3 N.	13 E.	D. C. Demarest, 503 Market St., San Francisco, or % L. Monte Verda, Altaville	19	R. XII, p. 90; XIII, p. 98
Bisbee						R. XIII, p. 98
Black George						See Lindsey
Black Walnut				Edward C. Weisbach and Chas. J. Shields, % L. Weisbach, San Andreas, or % C. J. Shields, R. F. D. 1, Box 1085, Modesto		
Black Wonder	27	6 N.	14 E.	Calaveras Mng. & Milling Co., Black Wonder Mng. Co., % Mr. Campbell, Mitchell Mill, or % H. J. Ferguson, 1845 11th St., San Jose	320	R. XIII, p. 98; XIV, p. 70; XVII, p. 421; XVIII, p. 18; XXI p. 145
Blair						See Triple Lode
Blazing Star	2	6 N.	13 E.	D. D. Merchant, 5416 4th Ave., Los Angeles		R. VIII, p. 141; XII, p. 90; XIII, p. 98; XIV, p. 71; XVIII p. 18
Blizzard & Mohawk No. 1	16	6 N.	13 E.	John E. Bardsley, West Point	74	
Blue Bell	17	6 N.	13 E.		60	R. XIII, p. 99; XIV, p. 71
Blue Bird				Mark Letora, Sheep Ranch		
Blue Jay	24 16	6 N. 6 N.	12 E. 13 E.	Leonie F. Schlund, 421 Perry St., Oakland	19	

Blue Jay	16	5 N.	12 E.	Allen H. McCarty, Mokelumne Hill	40	R. XIV, p. 71; XXI, p. 145
Blue Jay and Yellow Hammer						Bulletin 18, p. 123
Blue Ribbon				Raymond Cuneo, San Andreas		
Blue Ribbon	2, 3	4 N.	13 E.	Guido Kustell and R. E. Johnson, Mountain Ranch	12	
Blue Rock						See Afterthought
Bode						See Fellowcraft
Bolitha (or Hardy)	3	2 N.	13 E.	Lynch & Bolitha Mng. & Milling Co., % Austin Lynch, Rms. 1-5, Schaefer Bl., Canton, Ohio, or Lynch-Day-Fimple & Lynch, First National Bank Bldg., Canton, Ohio	21	R. XII, p. 93; XIII, p. 99; XIV, p. 71; Bull. 18, pp. 120-121
Bolitha Mng. & Milling Co.	2	2 N.	13 E.	% Austin Lynch, Rms. 1-5; Schaefer Bl., Canton, Ohio	133	
Bonanza	14	2 N.	12 E.	Gottfried Reusser and Adolph Reusser, Copperopolis	13	
Bonanza Pocket	2, 11	3 N.	13 E.	George Hauselt, 317 Ocean St., Santa Cruz	19	
Bon Ton	24	4 N.	13 E.	Mrs. Susanna D. Hewlett, et 3 al., % Tom E. Spear, 3406 W. Adams St., Los Angeles	13	R. XIV, p. 71
Boot Jack, Hill & Emma	10, 15	4 N.	10 E.	Ralph McGeen, Jackson and E. L. Stern, 2233 Divisadero St., Apt. 202, San Francisco	58	
Boston Cons.	5	5 N.	12 E.	Boston Cons. Mines Co., % S. L. Davidson, 154 Sutter St., San Francisco	131	R. XII, p. 90; XIII, pp. 99, 103; XIV, pp. 71-72; XXI, pp. 145-46; Bull. 18, p. 123
Bovee	33	3 N.	13 E.			Bull. 18, p. 119
Boulder Nos. 2, 3, 4; Black Oak et al.	4, 5 32, 33	6 N. 7 N.	13 E. 13 E.	A. C. Mattie, 251 Market St., San Francisco	99	
Bowden	26	5 N.	12 E.		20	R. XIV, p. 72
Brazza						R. XIII, p. 99
Bright Star	11	4 N.	11 E.			R. XIV, p. 72
Bright Star et al.	35, 36	6 N.	12 E.	Aladdin Gold Mng. Co., Holbrook Bldg., 58 Sutter St., San Francisco		
Brookdale	31	6 N.	13 E.	J. J. Simonich, 2645 74th Ave., Oakland		
Brown						See Tullock
Brown & Egan						See Utica
Brown & Scriver	28	3 N.	11 E.	P. S. Dean, Melton		
Brown, Smythe & Ryland Cons.	33	3 N.	13 E.	Pope S. Austin, 26 N. Jefferson St., Chicago, Illinois	31	R. VIII, pp. 126-129; X, pp. 60, 147-148; XII, p. 97; XIII, p. 99; XIV, p. 106; XVII, pp. 420-421; XVIII, pp. 97-98; Pre. Rep. No. 8, p. 25; Bull. 108, p. 128
Bruner	10, 11	2 N.	13 E.	Geo. E. Stickle and Mrs. Kate Kreft, % Geo. E. Stickle, Angeles Camp	14	R .X, p. 150; XI, p. 174; XII, p. 90; XIII, p. 106; XIV, p. 72; Bull. 18, p. 120; Bull. 108, p. 128
Buckhorn Cons.	1	3 N.	13 E.	Edward Miller, 3933 U St., Sacramento	69	R. XII, pp. 90-91; XIII, p. 99; XIV, p. 102
Buckhorn & Last Chance				John Guth, Mountain Ranch		
Buena Vista, Buena Fortuna, Los Gatos	8	6 N.	13 E.	V. P. Yelmene, 2905 Lincoln Ave., Alameda and Edward Peabody	11	R. VIII, pp. 146-147; XIII, p. 109; XIV, p. 72
Buena Vista				Frank S. Tower, Effie May Tower and Alice M. Bouldin, % Frank Tower, Milton		
Buena Vista				Robert Appleton % McCutchen & Olney, Balfour Bldg., San Francisco		

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TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Buhlert				Walter R. Wickham, 3305 Elm St., Oakland		
Bullion	10	2 N.	13 E.	Dr. Chas. D. Smith, Angels Camp	19	R. XIV, p. 72
Bullion	20	4 N.	14 E.		20	R. XIV, p. 73
Bullion Hill Quartz						See Washington
Cadillac Eight	19	4 N.	14 E.	T. J. Ehrhart; Frank Tucker, Sheep Ranch		
Calaveras						See Old Calaveras, also Enchantress
Calaveras or Calaveras Cons.	24	2 N.	13 E.	Carson Hill Gold Mng. Co., c/o Lawrence Monte Verda, Angels Camp	6	R. XI, pp. 169-170; XII, p. 91; XIII, p. 99; XIV, p. 73 XVII, p. 421; XXI, pp. 150-151; Pre. Rep. 6, p. 15; Bull 108, pp. 135-137
Calaveras Central				Calaveras Central Mng. Co., c/o Harry Sears, Angels Camp		
Calaveras Cons.	29	2 N.	12 E.	Calaveras Cons. Mng. Co., Ltd., 364 Mills Bldg., San Francisco	160	
California	22	4 N.	13 E.			R. XIII, pp. 99-100; XIV, p. 73
California Mother Lode						See Union
California Ophir	14	2 N.	13 E.	Mrs. Theresa Canepa Estate; c/o James Celle, Box 12, R.F.D. 2, Lodi; Mrs. Louis A. J. Airola, Carson Hill; Carson Hill Mng. Co., c/o Lawrence Monte Verde, Angels Camp	11	R. XIV, p. 73
Camille						See Cornmeal
Canepa	14	2 N.	13 E.	Mrs. Theresa Canepa Estate, c/o James Celle, Box 12, R.F.D. 2, Lodi, and Mrs. Louisa A. J. Airola, Carson Hill	20	
Canara	24	4 N.	14 E.		20	Field Report
Cangdon	10, 15	6 N.	13 E.	Retta L. Thompson, West Point		
Carabon & Good Chance	22	2 N.	13 E.	Harry T. Libby and Harry T. Libby, Jr., Melones		
Cardova et al.						See Union & Burgess Group
Carley & Little Carley	29	3 N.	13 E.	Gerolamo Guisto, Altaville	20	
Carlton	9	6 N.	12 E.	W. L. Phillips and H. T. Mason, West Point	44	R. XIII, p. 100; XIV, p. 73; Pre. Rep. No. 8, p. 26; XVIII p. 18
Carson	13, 24	2 N.	13 E.	Carson Hill Mother Lode Mines Co.	22	R. XII, p. 97; XIII, p. 120; XIV, p. 107
Carson Creek	23	2 N.	13 E.	Manuel Estate Co., Murphys		R. XII, p. 91; XIII, p. 100
Carson Hill Gold Mining Co.	13, 14 17, 18 24 19, 20	2 N. 2 N. 2 N. 2 N.	13 E. 13 E. 13 E. 14 E.	c/o Lawrence Monte Verda, Angels Camp	878	R. IX, p. 37; X, p. 57; XI, pp. 76, 169; XII, pp. 89, 91, 94, 95; XIII, pp. 96, 99, 109, 113, 116; XIV, pp. 66, 73, 92, 93, 97, 87; XVII, pp. 421, 423; XIX, pp. 16, 17; XX, p. 5; XXI, pp. 146-150; 150-151; XXVII, pp. 435-436; Bull. 18, p. 121; Pre. Rep. 8, p. 15; Bull. 108, pp. 129-137; U.S.G.S. pp. 157, p. 71
Caruthers	20	4 N.	14 E.	Desire J. Fricot, Angels Camp	20	R. XIV, p. 73

Casnelli						R. XIII, p. 100
Cataldo & Cataldo No. 2				J. S. Jack, San Andreas		
Champion	4	6 N.	13 E.	Mrs. Mary Ruffino, 579 Greenwich St., San Francisco	113	R. XII, p. 91; XIII, p. 100; XIV, p. 73; XVIII, p. 18
Chapparal & West Ext. of Chapparal	33, 34	4 N.	13 E.	Charles H. Cuneo, Esmeralda	40	
Chaparral Hill Group	11, 14	2 N.	13 E.	Miss Effie M. Meeker, Occidental; Julia E. Meeker, c/o Bank of America, Valley Ford and State of California	95	R. XIII, p. 100; XIV, p. 73; XXI, p. 151; Bull. 108, p. 137
Chapman	10, 11	5 N.	13 E.			R. XXI, p. 150
Charlotte				Max Ohme, San Andreas		
Cherokee						See Altaville
Chinese	9	3 N.	8 E.	Elizabeth E. Hauselt and Mrs. Caroline Graves, c/o Elizabeth E. Hauselt, 2199 California St., San Francisco		
Chino	11	6 N.	13 E.	Ella A. Hash, West Point	10	
Claude	10	2 N.	13 E.	Kate Moran Dorroh, 628 Broadway Blvd., San Leandro and Ethel H. Posey, 4246 4th St., Chico	17	
Cleveland						See Empire
Cloud	10	2 N.	13 E.	Kate M. Dorroh, 953 The Alameda, Berkeley	16	R. X, p. 148; XI, p. 174; XIII, pp. 100-101
Clover Leaf Q. & Lone Star P.	34	5 N.	10 E.	F. H. Salaun, Jr., Campo Seco	20	
Coarse Gold et al						See Klein Group
Collier	1	3 N.	14 E.	Jane T. Condit and Perry Condit, Murphys	21	R. XIV, p. 74
Collier	24	1 N.	11 E.	Henrietta Botcher Landborough, Box 145, Florin	6	
Colorado				Frank Pescia, Alvin Murray and C. A. Pescia, Sheep Ranch		
Columbia	11	2 N.	13 E.	Mrs. Rose Ferraris, 1457 Vallejo St., San Francisco	13	R. XIV, p. 74; Bull. 108, p. 137
Columbus	5 32	6 N. 7 N.	13 E. 13 E.	W. W. Gibson, 374 Bush St., San Francisco, and I. L. Marks	20	R. XIV, p. 74; Pre. Rep. 8, p. 26; XVIII, p. 7; 19; XIX, p. 18; XX, p. 76
Columbus				Columbus Morales Mng. Co., c/o A. P. Dron, Gen. Mgr., 2004 Yolo Ave., Berkeley		R. XIV, p. 74; R. XVIII, p. 19
Comet (see also Gospel)	6, 7	4 N.	12 E.	Frances B. Reed, San Andreas	20	R. XIII, p. 101; XIV, pp. 74, 82; XIX, p. 18
Commodore	7	4 N.	12 E.	Commodore Gold Mng. Co., c/o W. H. Clary, 333 Kearny St., San Francisco	19	R. XIV, p. 82; Bull. 18, pp. 106-107; Bull. 108, pp. 137-138
Concentrator	14	5 N.	11 E.	Henrietta Knight, Josephine C. Dickman, et al., c/o H. Dickman, Jr., 110 Sutter St., San Francisco		
Confidence						See Utica
Continental	33	7 N.	13 E.	Marian C. Miller, J. R. Wilbur et al., c/o J. R. bur, 1224 Maple Ave., Evanston, Indiana	20	
Cook	23	3 N.	13 E.	Domingo Roleri, Angels Camp	21	R. XII, pp. 91-92; XIII, p. 101
Cook & Ranor	7	5 N.	12 E.	Mokelumne River Power & Water Co., c/o Wm. Prindle, Mokelumne Hill	9	
Copenhagen				Mrs. B. C Anderson, 1546 11th Ave., Oakland		
Cordova	6	4 N.	13 E.	Jerry O'Brien, Medico-Dental Bldg., Stockton	40	
Corn Meal	13	6 N.	13 E.	Daniel Filippine, Mountain Ranch	20	R. XIV, p. 75
Cosgrove	33	3 N.	13 E.			R. XIII, p. 101; XIV, p. 75
Costa	3	2 N.	13 E.	Mrs. Carrie Costa, Angels; Janie and George B. Moore, Angels Camp	4	

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TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Cowbell	15	5 N.	13 E.	Estate of G. W. Getchell, San Andreas	19	
Cow Bell & Cow Bell Extension				C. H. Kucks, 4386 Montgomery St., Oakland	40	
Cow Trail				John A. Carlson & Sons, 348 E. 115th St., Los Angeles		
Crossette	3, 6 25, 31	2 N. 2 N.	13 E. 13 E.		40	R. XIV, p. 75
Crown Point	31	3 N.	14 E.		40	R. XII, p. 92; XIV, p. 75
Crown Point & Buckeye	1	3 N.	13 E.	M. H. Manuel, Murphys	40	
Crystal	33	3 N.	13 E.	James V. Coleman, Jr., 148 Montgomery St., San Francisco		R. XIII, p. 101; see Angels
C. S.				Eliz. R. Stalker, 823 Ashbury St., San Jose		
Culbertson	8	4 N.	13 E.			R. XIII, p. 101
Cuneo						See Economic
Curtis						See Star of India
Cushing						R. XIII, p. 101
Dam Fi No				James Bauman and Charles Davis, 233 W. 83d st., Los Angeles		
Dam Fi No No. 2 & Last Chance				James Bauman, Izora Bauman and Charles Davis, 233 W. 83d St., Los Angeles		
Dan Reynolds	26	6 N.	13 E.	Estate of Mrs. Annie L. Poe, c/o Ray Murphy, San Andreas; Edgar A. Poe, Ray W. Murphy and Alma Poe Murphy, San Andreas	17	
Dashaway & Missouri	17	3 N.	14 E.	Dave Copella, Douglas Flat	8	
Dead Horse						See Utica
Dean						R. XIII, p 102
Deerfoot	34	7 N.	13 E.		120	R. XIV, p. 75
Deer Lodge	12	3 N.	14 E.			R. XIV, p. 75
Defender				Domingo Rolleri and M. A. Maher, Angels		
Dell Reo Mng. Co.	3, 4, 7 9, 10 11, 21 33, 34 35	1 S. 1 S. 1 S. 1 S. 1 S.	12 E. 12 E. 12 E. 12 E. 12 E.	Dell Reo Mng. Co., c/o Devlin & Devlin, California Trust Bldg., Sacramento or 568 Wrigley Bldg., Chicago, Illinois	5,823	
Dalmatia	30	4 N.	11 E.		40	R. XIII, pp. 101-102; XIV, p. 76
Del Monte	5	5 N.	13 E.		100	R. XIV, p. 76
Demarest	9, 10, 15, 16	3 N.	12 E.	Demarest Gold Mng. Co., a corporation, c/o Lawrence Monte Verda, Angels Camp	14	R. XII, p. 92; XIV, p. 76; XXI, p. 151; Bull. 18, p. 107; Bull. 108, p. 138
Denslow						See Hidden Treasure
Diamond				Carson Hill Gold Mng. Co., c/o Lawrence Monte Verda, Angels Camp		

Diamond Jack & Poverty	14	2 N.	11 E.	J. F. Tower, Agnes Tower, F. S. Tower, J. A. Tower and J. Howard, Milton	40	
Discovery				Carson Hill Gold Mng. Co., c/o Lawrence Monte Verda, Angels Camp		
Doc Hill	33	3 N.	13 E.	James V. Coleman, Jr., 148 Montgomery St., San Francisco	5	See Angels Mine
Dodson	12	3 N.	13 E.		160	R. XII, p. 92; XIII, p. 112; XIV, p. 76
Dogwood & Round Top	18	6 N.	4 E.	Mary Sandoz, Mitchell Mill		
Dominion Group	25, 26 35, 36 6	7 N. 7 N. 6 N.	13 E. 13 E. 14 E.	Dominion Mng. Organization, Inc., 306 Merchants Exchange Bldg., San Francisco		R. XXI, pp. 151-152
Donnelan	7	4 N.	12 E.			R. XIII, p. 102
Dora Cons.						See Homestake & Hostler
Dragone	1 36	3 N. 4 N.	13 E. 13 E.	Pete Dragone, Box 274, Angels Camp	18	
Drake Properties						Bull. 18, p. 121
Dublin	19	2 N.	12 E.	Steven Gerow and Phoebe Gerow, c/o Mrs. Phoebe Gerow, 725 20th St., Oakland	19	R. XIII, p. 102
Dubovonich, Dalmazia & Austrea	21	2 N.	13 E.		62	
Dunlap						R. XIII, p. 102
Dutchess Cons.	5, 8, 9	2 N.	14 E.	Walter B. Lenhart, Ross C. Richey, John O. Eiler, Thos. B. House, and Gerald Toms, c/o R. C. Richey, 1177 Belmont St., Long Beach	90	R. XIV, p. 76
East No. 1				James R. Stevens, Murphys		
East No. 1; West No. 1, No. 2				M. T. Chestnut, Jr., Murphys		
Eastern Star				Charles Thomas, c/o R. T. Thomas, 1437 Berkeley Way, Berkeley		
Eastern Star				Lucy P. V. Dies, Angels		
Eastland						See Lightner
Easyz Bird	6	5 N.	12 E.	Lucky Joe Gold Mng. Co., c/o Max Muller, Hermosilli, Mexico, c/o Banco De Senora, or Lucky Mng. Co., Box 292, Jackson	20	R. X, p. 57; XII, p. 95; XIII, p. 113; IX, p. 37; XIV, p. 76; XVII, p. 423; XIX, p. 17; Pre. Rep. 8, p. 27; XXI, p. 152
Eberhardt	23	6 N.	13 E.	F. E. Herzer, Murphys	20	
Echo				L. F. Blake, R.F.D. 1, Box 270 A, Ripon		
Eclipse						R. XI, p. 171; XII, p. 92, 97; XIII, p. 102
Economic	33	4 N.	13 E.	Standard Amalgamated Exploration, Corp., c/o Victor Weil, Suite 57-58 Galm Bldg., 161 Summer St., Boston, Massachusetts	20	R. XIV, p. 77
Edna	11	4 N.	10 E.	J. R. Hoskinson & Co., 810 N. Linden Drive, Beverly Hills	21	
Edna	33	5 N.	11 E.	Edna Gold Mng. Co., 148 Ronado Ave., c/o J. S. White, Piedmont	77	R. XII, p. 92; XIII, pp. 102-103; XIV, p. 77
Eida	4	4 N.	13 E.		20	R. XIV, p. 77
El Cedro	25, 32			D. Potter, Mokelumne Hill		
El Dorado						See Bisbee
Emma						See Royal Consolidated
Empire & Cleveland Cons.	29, 30	2 N.	12 E.	Frank S. Tower, Milton	45	R. XIII, p. 103; XXI, p. 152
Empire Lode & Placer	33	3 N.	13 E.	Franklin T. Stevens, Box 2021, Angels; Mary A. Keyes, Angels Camp	15	

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TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Enchantress & Oro Minto	21	4 N.	14 E.	Mar-John Mines Co., Sheep Ranch		R. XII, p. 91; XIII, p. 115; XIV, p. 100; XXI, p. 157. Min. Res. W. of Rocky Mts., 1873, p. 35; 1876, p. 43
Enterprise						See Melones Consolidated
Eresta	3	2 N.	13 E.	Fred Pareto, Angels Camp	13	
Esmeralda & Sunrise	34	4 N.	13 E.	John F. Davis Estate, c/o Lillian Parks Davis, 2872 Jackson St., San Francisco	35	R. VIII, pp. 133-135; XIII, p. 103; XIV, pp. 77, 108
Esperanza						See Boston
Estrella De Chile & Oro Fino				Joseph C. Daza, Campo Seco		
Etna King	33	3 N.	13 E.	Etna King Mining Co., 1521 Castro St., Oakland	14	R. XIV, pp. 77-78; Bull. 108, pp. 151-152
Eureka	34, 35	7 N.	13 E.	Mary Rowe and Thos. H. Jenkins, West Point or Grass Valley	20	R. XII, p. 92; XIII, p. 103; XIV, p. 78
Eva				Estate of Mrs. Emeline J. Sorensen, c/o Eva R. Reynolds, West Point		
Evening Star	33	2 N.	13 E.	A. F. Salfield, 250 E. Mariposa Ave., Stockton	10	
Everlasting	19, 20	4 N.	12 E.	Sarah Scieffard and Annie Baumhogger, San Andreas	29	R. X, p. 63; XII, p. 92; XIII, p. 103; XIV, p. 78, 82. Bull 108, p. 137
Excelsior	23	3 N.	10 E.			R. XI, p. 175; XIII, p. 103
Excelsior or No. Ext. of Lamphear	18	5 N.	12 E.	Mrs. Almena Moser, Mokelumne Hill	47	R. XIII, p. 104; XIV, p. 78
Fairfax and Centennial	33 3	3 N. 2 N.	13 E. 13 E.	Grace L. Kuns, Box 1066, Angeles Camp	36	
Fair Play	1	3 N.	13 E.	Hattie L. Booksin et al., 1785 N. Hunter St., Stockton		
Falcon	1	3 N.	13 E.	Geo. L. Carley, Box 22, Murphys		R. XII, p. 94; XIII, p. 104
Fallen Pine	5	5 N.	14 E.	Frank Guillemin and L. G. Guillemin, Mist		
Fellowcraft	17	4 N.	12 E.	C. J. Tiscornia, San Andreas	10	R. X, p. 149; XI, p. 178; XII, p. 92; XIII, p. 104; XIV, p. 78 Bull. 18, p. 105; Bull. 108, pp. 138-139
Fenian	20, 21	4 N.	14 E.	Wm. C. Hunneman, Trustee for Willard Mng. & Milling Co., 53 State St., Rm. 1029, Boston, Mass.	12	
Ferguson	12	6 N.	13 E.		30	R. XIV, p. 78
Fidelity	30	6 N.	13 E.	Edward Gilomen, R.F.D., Mokelumne Hill	15	R. XIV, p. 78
Fine Gold; Prosperity & Success	29 (lots 40A and B	6 N.	14 E.	A. W. Pioda, 1112 Financial Center Bldg., San Francisco	24	R. VI, pt. 2, pp. 34-35; XIII, p. 104; XIV, p. 78
Fine Gold So. Ext., Morning Star				Mrs. Matilda Ann Huston Harrison, Railroad Flat		
Finian	20	4 N.	14 E.		20	R. XIII, p. 104; XIV, pp. 78-79
Finnegan	13	2 N.	13 E.	Carson Hill Gold Co., c/o L. Monte Verda; James Tarbat et al., Angels Camp	11	R. XII, p. 92; XIII, p. 104; XIV, p. 79; XVII, pp. 421-422; Pre. Rep. No. 8, p. 26; XX, p. 178; XXI, p. 153; Bull. 108, p. 139
Finnegan Ext.	13	2 N.	13 E.	James Tarbat, G. Oneto, Chas. Bean et al., c/o G. Oneto, Angels Camp	4	

First Chance				John C. Schoy, R.F.D., Box 15A, Mokelumne Hill		
Fish Group	35	6 N.	13 E.	L. B. Fish, Railroad Flat	15	
Fiume and Genoa				A. D. De Martini, c/o Mrs. F. Byan, 3815 San Juan St., Oakland		
Flamm						R. XIII, p. 104
Flapper	32	2 N.	13 E.	John L. Gagnon, Calaveritas		
Fler De Ora, Omega, Matilda & Golden Reward	20, 21	5 N.	13 E.	Lucebia Bennett, Caliente	54	
Florence	20	4 N.	14 E.		20	R. XIV, p. 79
Flour Sack; Flour Sack Cons.	15, 22	5 N.	11 E.	Francis H. Harding, Frank B. Moors, J. W. Collins, 510 Great Western Power Bldg., Oakland	100	
Foote & Thompson	26, 35	6 N.	12 E.			See Quartz Glen
Ford						See Apex
Ford So. Extension	17	4 N.	12 E.	Talton Hawkes, 1760 Page St., San Francisco		
Forest Creek Mng. Co.'s property	7, 18	6 N.	14 E.		192	R. XX, p. 76; XXI, p. 153
Fortunate				R. G. Adamson, c/o George S. Taylor, Murphys		
Foster	33	3 N.	13 E.	Frances E. Caster; Helen A. Cohn; Mary H. Nash, c/o Paul V. Cohn, 451 Arvilla St., San Francisco	4	
Four Hundred	5, 6	4 N.	13 E.		40	R. XIV, p. 109
Fox						See Angels Mine
Fraction				A. D. Stevenot, c/o Merced Hotel, Merced		
Franklin	20	3 N.	11 E.	Nellie McSorley, c/o Marie McSorley, 1778 Pleasant Valley Ave., Oakland, E. R. Williams, 698 Maud Ave., San Leandro et al.	60	
Freccero				B. Freccero, San Andreas		
Free, Lucky Strike et al.				Earl Wickham, Lillie M. Wickham, 921 S. Elena Ave., Redondo Beach		
French						See Arthur
French & Wood						See Melones
Fricot Group	23, 27, 28	4 N.	13 E.	Desire J. Fricot, Angels Camp	236	R. XIV, p. 80; 87
Fritz	28	3 N.	13 E.			R. XIII, p. 104
Galena	35	7 N.	13 E.	L. F. Breuner, 6th and K Sts., Sacramento		R. XIV, p. 82; R. XVIII, p. 21
G. A. R.						See Tracy
Garabaldi	24	3 N.	12 E.	Rosa Cassinelli, Norma Cerruti et al., 350 Euclid Ave., Oakland	21	
Garabaldi	24	5 N.	12 E.	N. B. Cormack, c/o M. F. Carpenter, Selby, or 1201 Battery St., San Francisco	18	R. XIV, p. 80
Garabaldi Q. & Malaspina P.	29, 30	6 N.	13 E.	Thos. P. Sufelton, 418 Turk St., San Francisco	32	
Gardella						R. XIII, p. 105
Gardner Cons.						R. XIII, p. 105; Bull. 18, pp. 123-124
Gerabaldi	29	6 N.	13 E.		33	R. XIV, p. 80
Geravanti	14, 15	5 N.	11 E.		112	R. XIV, p. 80
German Ridge & Jupiter	15, 16	3 N.	13 E.	German Ridge and Jupiter Gold Mines, c/o M. Christie, Box 1966, Angels Camp	82	R. X, p. 148; XI, p. 149; XIII, p. 105; XIV, p. 80
Gertrude	25 30	4 N. 4 N.	12 E. 13 E.	Jules J. Agostini, Angels Camp; Calaveras Cement Co., 315 Montgomery St., San Francisco	56	
Ghost	33, 34	3 N.	13 E.		821	R. XIII, p. 105; XIV, pp. 80-81
Gilbertson	23	7 N.	13 E.		40	R. XIV, p. 80
Gladstone						R. XIII, p. 105

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TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Glencoe	19, 20 30	6 N. 6 N.	13 E. 13 E.	Walter C. Childs, c/o S. M. Haslett, 60 California St., San Francisco	83	R. XIV, p. 81
Glencoe & Development	17	6 N.	13 E.	Wm. M. Nuner, San Andreas	16	
Glencoe Wonder et al.				M. W. Truitt, Glencoe		
Glenn Ext., Gordon et al.				Nellie E. Wicker et al., 341 N. Bright Ave., Whittier		
Goat Ranch	9, 10	2 N.	12 E.	Nassau Copper Co.	21	
Gold Bug				Clarence R. Kenyon, West Point et al.		
Gold Cliff & Pilot Knob	33	3 N.	13 E.	Hobart Estate Co. and Rose & Emma, 351 California St., San Francisco	25	R. X, p. 150; XII, pp. 92-93; XIII, p. 105; XIV, pp. 81-82; XVII, p. 422; Pre. Rep. No. 6, p. 17; Bull. 18, p. 111; Bull. 108, pp. 140-141; U.S.G.S. P.P. 157, pp. 71-72; M. & S. Press, Nov. 26, 1904
Gold Cliff				Sam Vukovich, John Kostich et al., Box 321, Jackson		
Golden Bell et al.	20, 21	4 N.	14 E.	Mary Jane Osselin, Sheep Ranch	64	
Golden Cup						R. XIII, p. 106
Golden Eagle	9	4 N.	14 E.	Edgar A. Poe, Adele Arey et al., San Andreas	20	R. XX, p. 5
Golden Gate						See Commodore
Golden Hill	(Lot 41) 1	4 N.	11 E.	C. C. Mathews and F. G. Cary, c/o F. G. Cary, 121 W. Pine St., Lodi	31	R. XIII, p. 106
Golden Reef						See Homestake & Hostler
Golden Sulphuret Cons.	12	3 N.	14 E.	Helen Hunter Monihan and Geraldine Hunter, Alta Mira Hotel, Sausalito	58	
Gold Galena	35	7 N.	13 E.		20	R. XIV, p. 82
Gold Hill, Gold Hill Ext. et al.	30, 31 32	3 N. 3 N.	13 E. 13 E.	Manuel Airola Estate, Altaville	20	R. XI, p. 172; XII, p. 93; XIII, pp. 105-106; XIV, p. 82
Gold Hill	29, 30 31	3 N. 3 N.	14 E. 14 E.	Charles Sanquinetti, Vallecito	5	
Gold Hill	11	2 N.	13 E.	Carrie Costa, Angels Camp	6	R. XII, p. 93; XIII, p. 106
Gold Hill, Gold Hill No. 2 & Gold Hill Fraction	13, 18	3 N.	14 E.	George S. Taylor and Wm. M. Nuner, Murphys	38	R. XIV, p. 82
Gold King, Black Bear & Silver King	26	6 N.	14 E.	John T. Jones, R.F.D., Mokelumne Hill	20	
Gold King No. 3 & Black Jack	11	4 N.	10 E.	Rose Catherine Gallagher, 1573 Shrader St., San Francisco	29	
Gold Knoll Mng. Co.						See Wilbur Womble
Gold Leaf				Estate of Otto Fletcher, c/o John Fletcher, Angels		
Gold Leaf	3	2 N.	13 E.	Frank Grillo and Reba Grillo, Angels Camp	6	
Gold Reserve Cons.						See Bruner
Gold Reward, Gold Reward No. 2 et al.				Gold Relief Mng. Co., 912 Pacific Bldg., San Francisco	20	
Gold Star				Theodore Jones, R.F.D., Box 28, Mokelumne Hill		

Gold Valley	32	3 N.	13 E.	Ethel H. Posey et al., c/o Courthouse Surveyer, Oakland	10	R. XIII, p 106
Goodenough						See Royal Consolidated
Good Hope Group	19, 20	6 N.	13 E.		80	R. XIV, p. 82
Good Hope et al.	22	5 N.	11 E.	Mrs. E. E. Caminetti, Jackson	21	
Good Hope, Sunrise and Calaveras Queen	18, 19	6 N.	14 E.		60	R. XIV, p. 82
Good Luck or Josephine				Clovis Laidet and Henry Sanquinetti, Railroad Flat		R. XIV, p. 88; Pre. Rep. No. 8, p. 26
Gospel & Comet	6, 7	4 N.	12 E.	O. R. Young et al., c/o R. E. Young, 511 Mercantile Bldg., Denver, Colorado	41	R. XIV, pp. 74, 82
Gottschalk	Lot 42, 7	4 N.	12 E.	Mrs. C. V. Gottschalk Estate, c/o C. L. Shinn, 1713 Burnett Way, Sacramento	25	R. XIII, p. 106-107; XIV, p. 83
Gould	14	2 N.	13 E.		81	R. XIV, p. 83
Graham Q.						See Big Spring
Grand Army				H. G. Gobleman, Mokelumne Hill		
Granite	33	7 N.	13 E.	Joshua Hendy Iron Works, 200 Pine St., San Francisco	21	
Grasshopper	4, 5	2 N.	14 E.		40	R. XIV, p. 83
Grasshopper						See Banner
Gray	23	7 N.	13 E.		21	R. XIV, p. 83
Great Divide	1	3 N.	13 E.		20	R. XIV, p. 83
Great Eastern & Oriental	11	6 N.	13 E.	Edna C. Brann et al., 1987 California St., San Francisco	14	
Great Western or Right Bower						R. XIII, p. 106; XIV, p. 83
Great Western	28	3 N.	13 E.	Annie Baumhogger and Sarah Scieffard, San Andreas	4	R. XIV, pp. 83-84;Bull. 18, p. 120; Bull. 108, p. 141
Greek						See Alpha and Omega
Green	36	4 N.	10 E.	John E. Shaw, Murphy	10	
Green Hood				Claud Collins et al., c/o Mrs. L. A. McGriff, Lodi, Box 370, Rt. 3		
Guadaloupe						See Homestead
Guiffra	12	5 N.	11 E.		20	R. XIV, p. 84
Gurley						R. XIII, p. 107
Gwin	21, 22 27, 28	5 N. 5 N.	11 E. 11 E.		600	R. VI, p. 2, p. 30; X, p. 67; XII, p. 93; XIII, pp. 107-108; XIV, pp. 84-85; Bull. 18, pp. 100-104; Bull. 108, pp. 141-142
Gwin Ext. No. 1	27	5 N.	11 E.	T. E. McSorley, Mokelumne Hill; Nellie C. McSorley, c/o Marie McSorley, 1778 Pleasant Valley Ave., Oakland; Henry W. Sieleman, Valley Springs	9	
Hamby & No. Ext. Quaker City	26	5 N.	11 E.	Robert Gallagher, Valley Springs	41	R. XIV, pp. 85-86
Hancock	10, 15	5 N.	11 E.	Julia M. Mitchell, Box 235, Martinez		R. XIII, p. 108; XIV, p. 85
Happy Jack	18	5 N.	13 E.	R. Wise, 11th and Broadway, Bank of Italy, Oakland		
Hard Lead						R. XIII, p. 108
Hardscrabble or Bull Frog	6	4 N.	13 E.	Louis Bauer and Linda Catching, Dorrington		
Hardy	11, 14	2 N.	13 E.	Haywood & Hobart Estates, M. P. Morgan et al. c/o F. C. Beedle, 11 W. Plaza St., Box 1013, Reno, Nevada	9	R. XI, p. 174; XII, p. 93; XIII, p. 112; XIV, p. 86; XXI, p. 154; Bull. 108, p. 142

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TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Hardy						See Bolitha
Harris						See Oriole
Harrison	14	6 N.	13 E.	Estate of J. J. Foltz		
Hatfield, Jr., Q. & P.	25	5 N.	11 E.	J. W. Hatfield, Jr., Mokelumne Hill	20	
Hartfold				Geo. A. Stewart and L. A. Stewart, San Andreas		
Hawkins Group	34	6 N.	12 E.	Hawkins Mng. Co., c/o E. F. Hawkins, P.O. Box 371, Stockton, California		R. XXI, p. 154
Haywood & Carpenter Co.	31 28, 30 31, 32	3 N. 3 N. 3 N.	13 E. 13 E. 13 E.	D. M. Carpenter, Box 116, Maiden, North Carolina	26	
Hazel Emma				George W. Carr, Jr., Benj. Opdyke and F. W. Clark, Mountain Ranch		
Heckendorn	18	6 N.	15 E.	Annie M. Raggio, Angels Camp	21	Reg. of Mines, Calaveras Co., 1903. Min. Res. W. of Rocky Mts., 1872, p. 79; 1873, pp. 35, 36
Helen	13	4 N.	11 E.	Rosa Casinelli and Norma Cerruti, 1059 Longridge Road, Oakland	13	
Helen Weber Con.	9	3 N.	14 E.	Weber Home Co., c/o Gerald D. Kennedy, 464 California St., San Francisco	22	
Hercules	19, 24 25, 30	4 N. 4 N.	13 E. 13 E.			R. XIII, p. 108; XIV, p. 86
Hesperides Mng. Co.						R. XX, p. 7
Hicks						R. XIII, p. 108
Hidden Treasure	1	3 N.	13 E.			See Manhattan
Hiensdorff	5	3 N.	14 E.		160	Field Report
Hinckley	3, 4	4 N.	10 E.		160	Field Report
Holland	20	4 N.	12 E.		300	R. XIII, p. 108; XIV, p. 86
Homestake & Hostler & Golden Reef	25, 26 35	4 N. 4 N.	13 E. 13 E.	Dora G. Mng. Co., Corp., c/o I. L. Rosenthal, 241-243 Geary St., San Francisco	67	R. XII, p. 92; XIII, p. 102; XIV, pp. 86-87
Homestake & Sotona De Oro				Edward McClancy, West Point		
Homestake	1	3 N.	14 E.		40	R. XII, p. 93; XIII, p. 108; XIV, p. 87
Homestead, Big Spring & Big Spring Ext.				S. R. Danielson, Mokelumne Hill		
Homestead & Guadaloupe						R. XII, p. 94; XIII, p. 108
Holmes	20	6 N.	13 E.		20	R. XIV, p. 86
Horseshoe	30	4 N.	14 E.	J. E. Shaw, Willis E. Hutchason et al., c/o John E. Shaw, Murphys, or W. E. Hutchason, 78 Olive Bank of Italy, Los Angeles		
Horseshoe	13	4 N.	11 E.	M. G. Dragonanovich, North Branch		
Hostler	3	4 N.	13 E.	Wm. R. O'Connell, c/o Chas. P. Snyder, San Andreas	20	
Hudson & North Branch	11, 14 13	4 N. 4 N.	11 E. 11 E.	MarieMacchiavello, Clorinda Alegretti, Anna Alegretti, 1648 Great Highway, San Francisco	45	R. XII, p. 94; XIII, p. 109; XIV, p. 87
Idaho Cons.	27	4 N.	13 E.	Desire J. Fricot, Angels Camp	60	R. XIV, pp. 80, 87

Idora	5	5 N.	12 E.		80	R. XIV, p. 87
Ilex	35	6 N.	12 E.			R. VIII, pp. 135-138; XII, p. 94; See Tiger & Anglo-Saxon. U.S.G.S., Jackson Folio (reprint Sacramento, Placerville, Jackson, p. 9)
Illinois	16	3 N.	12 E.	Lurline Tilden, 626 S. Spring St., Los Angeles; Frances M. Young, Lagunitas Road, Ross	20	R. X, p. 149; XII, p. 94; XIII, p. 109; XIV, p. 87; Bull. 18, p. 107
Imperial	23	2 N.	13 E.	Mrs. Louisa A. J. Airola, Carson Hill	20	
Independence	28, 29	4 N.	14 E.	George S. Taylor, Murphys		
Indian Creek Gold Mng. Co.	34 3	4 N. 3 N.	13 E. 13 E.	c/o Metal Operator's Corp., Rm. 2911, 60 E. 42d St., New York	45	R. XXI, p. 155
Ingomar Cons.	34, 35	5 N.	10 E.	Ingomar Cons. Gold Mng. Co., c/o A. Moss, R.F.D. 3, B. 609, San Jose; or 711 First Nat'l Bank Bldg., c/o N. E. Wretman, San Jose	65	R. XIV, p. 58
Ipswitch & French Gulch				Walter R. Brooks, Esmeralda		
Iron Rock	14	2 N.	13 E.	Carson Hill Gold Mng. Co., c/o Lawrence Monte Verda, Angels Camp	15	R. XII, p. 94; XIII, p. 109; XIV, p. 87; XXVII, pp. 435-436
Irwin & McMillan	13, 14	2 N.	13 E.	Carson Hill Gold Mng. Co., c/o L. Monte Verda, Angels Camp	29	
Isabel	30	3 N.	14 E.		11	R. XIV, p. 88
Jackson	13	4 N.	11 E.		20	R. XIII, p. 109; XIV, p.88
Jackson						See Utica
Jane Morgan	15	3 N.	10 E.	Joseph M. Kidd, 445 W. Rose St., Stockton	20	
January	33	3 N.	13 E.	Mary Adeline Minard, Angels Camp; Dorothy W. McClure, c/o H. E. Trumbo, 318-324 Kearny St., or 866 25th Ave., San Francisco	10	
Jenkins						R. XIII, p. 109
Jersey				Cord Chas. Moller, Estate of, c/o Mrs. Alma Moller Gann, Valley Springs		
Joe Dandy	26, 27	4 N.	13 E.	Antone Pozar, Esmeralda		
John Buck	28	3 N.	13 E.	Earl E. Finley et al., Box 32, Altaville; Thomas Moore, c/o Geo. C. Moore, 1349 Sanchez Ave., Burlingame	7	
Johnnie & Pat	33	3 N.	13 E.	Samuel Austin Pope, 26 N. Jefferson St., Chicago, Illinois	365	
Johnson				Agnes M. Morgans et al., c/o F. C. Beedle, 11 W. Plaza St., Box 1013, Reno, Nevada		
Jolly Molly	11	4 N.	10 E.	G. H. Rohrbacher, Medico-Dental Bldg., Stockton	40	
Jolly Tar & Mariposa	28	3 N.	13 E.	Dirce Fazzi, Alvia Wood et al., Altaville	30	R. XX, pp. 5, 178; Bull. 108, p. 142
Jones	25	2 N.	13 E.	M. H. Manuel, Murphy	20	R. XI, pp. 173-174; XIII, p. 109; XIV, p. 88
Josephine						See Buena Vista
Jumbo						See Empire Cons.
Jumper	29	4 N.	14 E.		20	R. XIII, p. 117; XIV, p. 88
Kate Hageman	6, 7	4 N.	12 E.			See Comet
Kathleen	19	2 N.	12 E.	August Nelson, Copperopolis	5	
Kaiser Wilhelm	5 32	5 N. 6 N.	13 E. 13 E.	Enright Estate Co., a corporation, 2577 Rose Ave., Berkeley		
Kelly						R. XIII, p. 109
Keltz	25	7 N.	13 E.	Julia B. Higgins, 2166 Murray	21	R. XII, p. 94; XIII, p. 108; XIV, p. 88; Pre. Rep. No. 8, p. 27; XVIII, p. 19; XIX, pp. 17-18

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TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Kenross	11, 12	5 N.	12 E.		320	R. XIV, p. 83
Kentucky	14	2 N.	13 E.	Carson Hill Gold Mng. Co., c/o Monte Verda, Angels Camp		
Keystone	20, 29	3 N.	13 E.	Ben Lenxwiler, Hulda Hazelquist et al., c/o John Malaspina, Altaville		
Keystone, Pay Day, Triangle and Nellie Buyck	25, 26 35	6 N. 6 N.	13 E. 13 E.	Granada Gold Mines Corp., c/o Geo. R. Woodin, Rm. 84, N. 89 State St., Boston, Massachusetts	62	R. XIII, p. 110; Field Report
Kentucky House	29	4 N.	12 E.		160	R. XII, p. 94; XIII, p. 110; XIV, p. 88
Kidoo						R. XIV, p. 88
King	6	3 N.	14 E.	Marian Armstrong, Murphys	5	
King Solomon				Clarence R. Kenyon, West Point		
K. J.	34	4 N.	13 E.	D. C. Demarest and Rosa Moores, Hobart Bldg., San Francisco	20	R. XIV, p. 88
Klein Group				Earl Klein, San Andreas		
Kramer Group				Chas. W. Kramer, San Leandro		
La Belle & Betsy Anne				Carrie Bell Lowe, San Miquel		
La Chispeta				Charles Valente, Sr., c/o D. Fricot, Angels Camp		
La Fortuna						See Lucas
Lamphear	18	5 N.	12 E.	Roanoke Mng. Co., c/o L. S. Wetmore, 1445 N. Orange St., Stockton	24	R. XII, p. 94; XIII, p. 110; XIV, p. 89; XIX, p. 18; XX, p. 76; XXI, p. 155
Lane & Tulloc						See Madison
Last Chance Cons. & Angelica Innocente	13 18	3 N. 3 N.	13 E. 14 E.	Innocent Calzasia Estate, c/o Pauline Klein, 2417 E. Church St., Stockton	57	
Last Chance				Bryan Doster and F. L. Blake, c/o F. L. Blake, Rt. 1, Box 270A, Ripon, or Mountain Ranch		
Last Chance	30	2 N.	12 E.	Dr. E. W. Werrich, Angels Camp	11	
Last Chance	30	2 N.	12 E.	Estate of D. Cabrea et al.	11	
Last Chance				A. Zimmerman, Railroad Flat		R. XIV, p. 89
Last Chance	34	3 N.	13 E.		38	R. XI, p. 77; XII, p. 94; XIII, p. 110; XIV, p. 89; Bull. 18, p. 122
Last Chance	18	4 N.	13 E.	Mrs. Mary A. Haupt, Valley Springs	20	
Last Chance				Rufus F. Mobley, Milton		
Lawrence				Herman C. Cordes, Andrew L. Oneto and John Airola		
La Verne				B. J. Oydlott and Joseph F. Wright, 1608 Derby St., Berkeley		
Legal Tender et al.	24	4 N.	13 E.	George S. Taylor, Murphys		R. XIII, p. 110; XIV, p. 89
Leonard						See Wyllie
Lewis						See Gold Hill
Lewis	10	5 N.	11 E.	F. E. Young et al., 268 Market St., San Francisco	89	R. XIII, p. 110

Lightner	33	3 N.	13 E.	Lightner Mining Co., c/o B. F. Wellington, Jr., 2747 Haste St., Berkeley	2	R. XIII, p. 110; XIV, p. 89; XVII, p. 422; Bull. 18, pp. 109-111; Bull. 108, pp. 143-144; 191-192
Lillian				E. P. Rowe, R. W. Paget, c/o R. W. Paget, 444 N. Ophir St., Stockton		
Lincoln & Rattlesnake				Wm. E. Golta, Box 101, Mokelumne Hill		
Linderaxa				Mrs. Kate Vandell and Thomas J. Tynan, c/o Tynan, 355 Frederick St., San Francisco		R. XIII, pp. 110-111
Lindsey	33	3 N.	13 E.	Hobart Estate Co. and Rose, Emma, a corporation, 351 California St., San Francisco	24	R. X, p. 151; XI, p. 174; XIII, p. 111; XIV, p. 90
Little Hero	3	4 N.	13 E.		20	R. XIV, p. 90
Little John				A. M. Ross, 3999 Wittle Ave., Oakland		
Little Wonder	4	2 N.	12 E.	Dante Oneto, San Andreas		
Live Oak or Halley	2, 3 10	4 N. 4 N.	13 E. 13 E.	Nick Cuslidge, Mountain Ranch	360	
Live Oak, No. 1, No. 2	34	5 N.	13 E.		20	R. XIV, p. 90
Live Oak & S. Ext. Berkeley		3 N.	11 E.	E. A. Juleen and H. H. Smith, 543 N. Center St., Turlock		
Lockwood et al.	1, 12 6	6 N. 6 N.	13 E. 14 E.		48	R. VIII, pp. 138-141; XIII, p. 111; XIV, pp. 90-91; XVIII, pp. 19, 21
Log Cabin & Gold Chest				Luke C. Fisher, West Point		
London	6 4	4 N. 4 N.	13 E. 12 E.	John Zwinge, Mountain Ranch		
Lone Point	18	6 N.	14 E.		21	Field Report
Lonesome Pine				Myrtle L. Rader, Mokelumne Hill		
Lone Star, Reed & Hillary, Reed & Hillary Ext.	5 32	6 N. 7 N.	13 E. 12 E.	Chas. W. Stone, c/o Geo. H. Hudson, Box 11, Folsom	22	R. X, p. 152; XII, p. 94; XIII, p. 111; XIV, pp. 91-92; Pre. Rep. No. 8, p. 27; XVIII, p. 20; XIX, p. 17; XX, p. 76
Lone Star	11	5 N.	13 E.	John B. Tate, R.F.D. 1, Mokelumne Hill		
Lone Star	7	4 N.	10 E.	Bert R. Smith, Camanche	20	
Long Gulch						R. XIII, p. 111
Longworth & Nugget and Mable Fay	32	3 N.	13 E.	Minnie Mac Raymond and Phillips Pache, c/o F. M. Raymond, Box 71, Altaville	41	
Lookout	1, 12	4 N.	11 E.	W. T. Robinson et al., c/o E. T. Prather, Hotel Belleview, San Francisco	27	Field Report
Lookout Mountain Mng. Co., Ltd.	1, 12	4 N.	11 E.	Mokelumne Hill	40	
Lopez	33, 34	4 N.	13 E.		20	R. XIV, p. 92
Lost				R. H. and W. J. Crowell, Box 44, Walnut Grove		
Lost Boy	7, 18	4 N.	14 E.	Mary E. Ronan et al., c/o Wilmer W. Morse, 706 Capital National Bank Bldg., Sacramento	7	
Lost Log & Morning Star	20	3 N.	11 E.	H. L. Donner, Milton	41	
Lost Parrot	13, 18	3 N.	14 E.	Joe Lavagnino, Angels Camp	18	
Louisa						See Falcon
Louise, Fortuna et al.	12	3 N.	14 E.	Henry R. Poeland, 461 24th St., Oakland	20	R. XIX, pp. 18, 143-144
Lucas	1	5 N.	11 E.		20	R. XIV, p. 92
Lucky Boy	4	3 N.	12 E.			
Lucky Jim	18	4 N.	13 E.	Maud E. Gerry		
Lucky Joe Gold Mng. Co.						See Easyz Bird
Lucky Strike & Linda Vista	26	6 N.	14 E.	Frances J. Laidet, Railroad Flat		

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TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Machu						See San Antonio
Madison	33	3 N.	13 E.	Hobart Estate Co., and Rose & Emma, 351 California Street, San Francisco	12	R. XI, p. 171; XII, p. 95; XIII, pp. 111-112; X, p. 151; Bull. 108, p. 144
Magruder						See Star
Main & Fort Ritter	27, 34	5 N.	13 E.		40	R. XIV, p. 92
Ma Ka Lac A Rose				S. B. Gardner, Murphys		
Maltman						R. XIII, p. 112; Bull. 108, p. 145
Maltos & Mexican	30	2 N.	12 E.	Juan Maltos, R.F.D. 6, Box 119, Stockton	22	R. XXI, p. 155
Maloney	12	5 N.	11 E.		160	R. XIII, p. 112; XIV, p. 92
Mammoth & Eclipse	24	6 N.	13 E.	Lucebia Bennett, Caliente	25	
Mammoth & Jumper	5, 6	5 N.	12 E.		80	R. XIV, p. 92
Manhattan et al.	1 36	3 N. 4 N.	13 E. 13 E.	Thomas G. Denslow and M. H. Manuel, c/o W. F. Gormley, 2015 M St., Sacramento	53	
Marble Springs	3, 10	2 N.	13 E.	Agnes M. Morgans et al., c/o F. C. Beedle, 11 W. Plaza St., Box 1013, Reno, Nevada	16	(See Mother Lode Central Mines, Inc.), R. XIV, p. 72
Marble Springs						See Big Spring
Maria & Fortuna	34	4 N.	13 E.			See Indian Creek Mng. Co.
Marie's Hill View				Marie Kraft, Box 76, Valley Spring		
Marino	12	6 N.	13 E.		20	Field Report
Mar John				(See Enchantress)		R. XII, p. 91; R. XIV, p. 115; R. XX, p. 178; XXI, p. 142
Marshal						See Cushing
Martha	34	5 N.	13 E.	Charles B. Coulter, Mountain Ranch	20	R. XIV, p. 92
Mary Belle	32	3 N.	13 E.	Stephen Susich, R.F.D. 1, Box 313, Stockton	20	
Mascot	2, 11 12	3 N. 3 N.	14 E. 14 E.	George S. Taylor, Murphys	19	
Matrimony	2	6 N.	13 E.	Chas. A. Randlett, 2866 Santa Clara Ave., Alameda	11	
Matson						See Madison
Max Cons.	25, 26	4 N.	13 E.	Max Gross and Beckie Gross, 1040 18th St., Oakland	39	
Maxwell						R. XIII, p. 112
May Day	6	3 N.	14 E.	Carson Hill Gold Mng. Co., c/o L. Monte Verda, Angels Camp		R. XIV, p. 92
Mayflower	6	3 N.	14 E.	J. G. De Forest et al., c/o Chas. A. Shurtliff, 564 Market St., Chanery Bldg., San Francisco		
Mayflower et al.	23	3 N.	10 E.	Claude Collins et al., c/o Mrs. L. A. McGriff, Lodi; Paul Sinclair, c/o W. F. Sinclair, Jenny Lind	57	
May Pole	12	5 N.	11 E.	M. L. Lichtenfeld and N. W. Mahaffey, c/o Ida Lichtenfeld, 109 E. Flora St., Stockton	11	
Melones	24	2 N.	13 E.	Carson Hill Gold Mng. Co., c/o L. Monte Verda, Angels Camp		R. XII, p. 95; XIII, pp. 112-113; XIV, pp. 93-96; XVII, p. 422; XVIII, p. 98; XX, p. 5; XXI, p. 147; Pre. Rep. No. 6, pp. 15-17; Bull. 18, pp. 120-121; Bull. 108, pp. 133, 134-135

Merrimac						See Allison-Merrimac
Mester	13, 14	4 N.	11 E.	Mrs. Marie Mester, 2451 63d Ave., Oakland	8	R. XIV, p. 96
Meteor						R. XIII, p. 113
Mexican	11	6 N.	13 E.		20	R. XIV, p. 96
Meyer						See Utica
Meyer & Love	29, 32	3 N.	13 E.	Mrs. Amelia Meyers et al., 22 E. Rose St., Stockton	82	
Michel & Michel Ext.	3, 10	5 N.	13 E.	John Gnecco and John H. Tone, Mokelumne Hill	17	
Midnight et al.				Willard Mobley and Wm. Mobley, c/o Wm. Mobley, R.F.D. Box 1320, Stockton		
Midwinter & Native Son	10, 11	3 N.	12 E.	Kirby Development Corp., San Andreas	11	
Mina De Oro				Eugene G. Staples, Sheep Ranch		
Mina Rico	7, 12	6 N.	14 E.		60	R. XIV, p. 96
Mineral King	18	5 N.	13 E.			R. XIII, p. 113
Mineral Mountain						See Melones
Minnie	19	6 N.	13 E.		20	R. XIV, p. 96
Minnie Hennesay				James V. Coleman, Jr., 148 Montgomery St., San Francisco		See Angels Mine
Minona et al.				C. H. Luke, 908 Evans Ave., Reno, Nevada		
Missouri & Santa Ana	11	2 N.	13 E.	Andrew L. Oneta, Carson Hill		
Mitchler Group	1	3 N.	13 E.	Glendon L. and Eugene F. Mitchler, Murphys	40	
Mitchell	10	5 N.	13 E.		20	R. XIV, p. 97
M. J. B. et al.				Joseph Sanguinet, West Point		
Modoc						See Dominion Group
Mohawk	31	3 N.	13 E.	F. M. Raymond, Altaville	6	R. XXI, p. 156; Bull. 108, p. 145
Mohawk						R. XIV, p. 97
Mokelumne				J. G. Donaldson and W. L. Desnoyers, Mokelumne Hill		
Montana	25	5 N.	12 E.	O., A. and Jas. Scossa Ghiringhelli and Mazzini Gattavaro, c/o M. Gattavaro, Mountain Ranch	20	R. XIII, p. 113; XIV, p. 97
Monte Christo				Joseph S. Wright, 1608 Derby St., Berkeley		R. XIV, p. 97
Morgan	13, 14	2 N.	13 E.	Carson Hill Gold Mng. Co., c/o L. Monte Verda, Angels Camp		R. IX, p. 37; XII, p. 95; XIII, p. 113; XIV, p. 97; XVII, pp. 423-424; XXI, pp. 147-150; Pre. Rep. No. 8, p. 27; Bull. 108, pp. 129-133
Morning Star	3, 10	2 N.	13 E.	James and John P. Lagomarsino and Domingo Rolleri, Angels Camp	20	
Morning Star	19	2 N.	12 E.	Mrs. Kate Greenhalgh, Knights Ferry	16	
Morning Star	11	5 N.	13 E.	M. H. McGary, R.F.D., Mokelumne Hill	20	
Morning Star				Ed Seiffert and James Trengove, c/o Ed Seiffert, San Andreas		
Moser	18	5 N.	11 E.	Florence M. Sauve, Mary E. Moser and Clara E. Fisher	45	R. XII, p. 95; XIII, p. 117; XIV, p. 98
Mother Lode Central Gold Mines						See Lamphear
Mound City						See Calmo
Mountain King	19, 30 24	2 N. 2 N.	12 E. 11 E.	Robert B. Parks, 130 E. Walnut St., Stockton et al	19	R. XIII, p. 113; XIV, p. 99; XXI, pp. 155-156
Mountain View	30	6 N.	13 E.		160	R. XIV, p. 98
Mount Nebo	30	3 N.	14 E.	Estate of Mrs. Catherine J. Hambleton, c/o Jos. Martin, Box 498, Sonora	8	R. XIII, p. 114; XIV, p. 98

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TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Mount Ophir						R. XIII, p. 114
Mount Timolus	36	5 N.	12 E.	Margaret Jack and A. E. Pomeroy, c/o J. S. Jack, Mountain Ranch		R. XIV, p. 98
Mullen						See Casnelli
Murphys	31	4 N.	14 E,	Angels Creek Mng. Co., c/o W. C. Hunnaman, 33 State St., Boston, Massachusetts	10	
Murray Bonanza	14	2 N.	13 E.	Estate of J. P. Murray, c/o Mrs. J. P. Murray, Angels Camp		
Murray Creek Cons.	34	5 N.	13 E.	Murray Creek Mng. Co., 302 26th St., Oakland, c/o Henry Gloy	40	R. XIII, p. 114
McCormick						See Angels
McKinley						R. XIII, p. 112
McKinty	23	6 N.	13 E.	J. G. Thompson and Jas. D. Good	40	
McPherson	30	4 N.	13 E.	Calaveras Cement Co., Inc., 315 Montgomery St., San Francisco	16	
McQuig						See Dodson
Naples & Venica	19	3 N.	13 E.	Rosa Cassinelli & Norma Cerruti, 350 Euclid Ave., Oakland	43	
Napoleon	23	1 N.	11 E.	Edw. H. Nutter and Gertrude A. Nutter, 220 Battery St., San Francisco	16	
Nelson	14	6 N.	13 E.			R. XIV, p. 98
Never Sweat	13	4 N.	11 E.	Rosalie M. Brown, 2 S. Delaware St., San Mateo	14	R. XIII, p. 114
New Year	14	2 N.	13 E.	Carson Hill Gold Mng. Co., c/o L. Monte Verda, Angels Camp	15	
New Yellow Jacket et al.				R. A. Ritchie, 1724 Webster St., San Francisco		
New York	31	6 N.	13 E.		20	R. XII. p. 96; XIII, p. 114; XIV, p. 98
Nigger Hill Shale	11	4 N.	10 E.	F. A. Costello, 2265 E. 12th St., Oakland	21	
Nine Spot				Verne J. Hoffman, R.F.D., Box 15-B, Mokelumne Hill		
Nixon	2	6 N.	13 E.		160	R. XIII, p. 114; XIV, p. 98
Norrie						See Afterthought
North End	33	3 N.	13 E.	Dr. George F. Pache, 831 N. Hunter St., Stockton or Angels Camp	14	
North End						See Etna King
North Star	13	2 N.	13 E.	Thos. B. Bishop Co., 166 Geary St., San Francisco	30	
North Star	1, 12	6 N.	13 E.		125	R. XIII, p. 115; XIV, p. 99
North Star	25	7 N.	13 E.	Chas. S. Harker, 1212 Humboldt Bank Bldg., San Francisco et al.		R. XIII, p. 123; XIV, p. 99; XXI, pp. 151-152
North Star & Albany	33	3 N.	13 E.	Orval Overall (trustee), W. B. Rowland, W. W. Collins, Geo. W. Stewart and E. H. Osborn, Sec. First Nat'l Bank of Los Angeles, Box 1311, Fresno	13	R. XIV, pp. 98-99; Bull. 108, p. 145

Norwich	19, 30	6 N.	13 E.		20	R. XIV, p. 99
Novella	11	6 N.	13 E.		30	R. XIV, p. 99
Nucleus	19, 30	6 N.	13 E.	John J. McSorley, Mokelumne Hill	6	
Ohio	25	3 N.	14 E.		20	R. XIV, p. 99
Ohio						Field Report
Okium & Okium N. Ext.	23, 26	7 N.	13 E.	Winifred Bradford, c/o Mrs. A. S. Bradford, R.F.D. 1, Box 565, La Canada	25	
Old Calaveras				See Mar John		Min. Res. W. of Rocky Mts., 1873, p. 35; 1876, p. 43
Old Gray	23, 24 25, 26	7 N. 7 N.	13 E. 13 E.	Thomas and Mary E. Porteous, West Point		
Old Henry						See Eureka
Old McKenney	10, 11	4 N.	13 E.	A. Domenghini, Mountain Ranch et al.	17	R. XIV, p. 99
Old Washington	32	4 N.	14 E.		40	R. XIV, p. 99
Old Whisky	9	6 N.	13 E.	James H. Thompson, West Point		
Oneida	33	3 N.	13 E.	James V. Coleman, Jr., 148 Montgomery St., San Francisco	16	See Angels Mine
O. O.	25	5 N.	13 E.	Jos. C. Dell Orto, Mokelumne Hill		
Ophir Cons., Red Hill & Woodstock Ext.	26, 35	5 N.	11 E.	Frank Bernardi, 2226 N. California St., Stockton et al.	78	
Oriole	34	3 N.	13 E.			R. XIV, pp. 99-100; Bull. 18, p. 121; Bull. 108, pp. 145-146
Oro Fino						See Pilot
Oro Minto						See Old Calaveras Group
Oro Plata et al.	5, 6	3 N.	14 E.	Union Cons. Mng. Co., c/o Geo. Searle, Sec., 155 Montgomery St., Alexander Bldg., San Francisco	75	R. VI, pt. 2, pp. 35-42; XII, pp. 96, 99; XIV, p. 100
Osborn Cons.	30	3 N.	13 E.	Geo. W. Osborn, Elmer J. Osborn et al., c/o E. J. Osborn, Altaville	10	Bull. 108, p. 146
Oslin						See Washington
Our Flag et al.	19	2 N.	14 E.	Mary A. McArdle, 344 W. Park St., Stockton	8	R. XIII, p. 115
Palo Alto, Gold Zone et al.	18 13	6 N. 6 N.	14 E. 13 E.	W. T. Pidwell, 417 Market St., San Francisco	53	
Panucco Cons.	29, 30	3 N.	13 E.	Thos. E. Byrnes, Ethel I. Cahalan, 808 Laurel Ave., San Mateo et al.	40	
Paragon	13	6 N.	13 E.		60	R. XIV, p. 100
Parnell	30	3 N.	13 E.	J. E. Oliver Estate, c/o Louttit-Marcean, Atty's, Stockton	5	
Particelli						R. XII, p. 96; XIII, p. 116
Paul Cons.	13	5 N.	11 E.	Paul B. Lancell, Mokelumne Hill	60	
Pearlene	30	3 N.	13 E.	R. S. Hall, Altaville	4	
Peek Ranch	5, 6	5 N.	12 E.		280	R. XIV, p. 100
Peirano	14	2 N.	13 E.	Louisa May and Jos. F. Peirano, 2118 Hayes St., San Francisco	13	R. XIII, pp. 115, 119
Perlina						Bull. 18, p. 120; see also Maltman
Petticoat et al.	26	6 N.	13 E.	E. A. Poe, Ray W. Murphy and Alma Poe Murphy, San Andreas	59	R. XIV, p. 100; XIII, p. 115
Phillips & Mason	9	6 N.	13 E.	W. R. Phillips and H. T. Mason, West Point	40	
Pierce						See Deer Lodge
Pilot	14	4 N.	13 E.		20	R. XIV, p. 100-101
Pineapple						R. XIII, p. 115
Pine Cone				Claude I. Eaton, R.F.D. 1, Box 407, Stockton		
Pine Log No. 3				Martin Womble, Copperopolis, and Jackson D. McCarty, Milton		

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TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Pine Log						See Royal Cons.
Pine Nut				Adolph Becker, Angels Camp, and Wm. T. McFall, Altaville		
Pioneer						See Brown, Smythe & Ryland
Pioneer	33	3 N.	13 E.	S. Austin Pope, 26 N. Jefferson St., Chicago, Illinois	6	
Pioneer	11	1 N.	11 E.	Jackson D. McCarty, Milton	20	
Pioneer Chief	29	4 N.	12 E.	Mrs. Lurline S. Tilden, 626 S. Spring St., Los Angeles; Frances M. Young, Lagunitas Road, Ross	14	R. X, p. 63; XIII, p. 115; XIV, p. 101; Bull. 108, p. 146
Pioneer Lode & Oro Fino P.	30	4 N.	13 E.	Columbo Cademartori, David Cademartori and Louis Cademartori, San Andreas	80	
Plymouth Rock	23	3 N.	10 E.	H. E. Barker et al., c/o Wallace Collins, Attorney, Jenny Lind	9	R. VIII, pp. 147-148; XIII, pp. 115-116; XIV, p. 101
Pocket Democrat	33	3 N.	13 E.	Nellie Cencevich and Estate of Martin Cencevich, Angels Camp	6	
Poorman & Lawson	21	6 N.	13 E.	California Rand Mng. Co., c/o Mrs. Phillips Klein, 2312 Fairmont Ave., Philadelphia, Pa.		R. XIII, p. 116; XIV, p. 101-102. Min. Res. W. of Rocky Mts., 1872, 1873
Point Rock	13, 24	2 N.	13 E.	Carson Hill Gold Mng. Co., c/o L. Monte Verda, Angels Camp	9	R. XIII, p. 116
Porteous Group	13 18, 19	6 N. 6 N.	13 E. 14 E.	George J. Porteous, Box 24, West Point		
Port Arthur						See Tollgate
Potter	33	3 N.	13 E.		12	See Angels
Poverty	8, 9	3 N.	14 E.			R. XIII, p. 116
Pozar	22	4 N.	13 E.	Antone Pozar, Esmeralda, et al.		
Price	7	6 N.	14 E.			R. XIV, p. 101
Prince						See Tollgate
Prospect						See Johnson
Prosperity						R. XX, p. 76
Purdy Group	20, 21	3 N.	11 E.		59	R. XIV, p. 101
Pure Quill						R. XIII, p. 116
Purington Golden Treasure						R. XX, p. 7
Quaker City	26	5 N.	11 E.	Quaker Gold Mng. Co. (a corporation), c/o Cora Beardsley, 637 Viona Ave., Oakland	25	R. VIII, pp. 144-146; XIII, p. 116; XIV, p. 101; Bull. 108, pp. 146-147
Quartz Glen	26, 35	6 N.	12 E.	Frank J. Solinsky, Berkeley, Percy Peek, Mokelumne Hill, et al.	92	R. XIII, p. 116; XIV, p. 101
Quartz Lode	6	4 N.	12 E.	Mrs. Kate Hageman, Mrs. Nellie Nuner et al., San Andreas	20	
Rabbit Foot				Fred J. Anderson (lessee)	40	

Raffetto Group	8, 9	3 N.	14 E.	Katherina Raffetto, Murphys		
Rainbow				W. R. Cutts, 3712 Floral Ave., Los Angeles, et al.		
Rainbow	5	5 N.	14 E.	Louise Guillemin, Mist		
Ranch						See Sherman Ranch
Raspberry						See Utica
Rasmussen Estate						See Triple Lode
Rathgeb	33, 34	4 N.	12 E.	Frances B. Reed, San Andreas	15	R. VIII, p. 147; X, p. 63; XII, p. 96; XIII, p. 116; XIV, p. 102; Bull. 108, p. 147. Trans. A.I.M.E., 1901
Rebecca Mg. & Mg. Co.	20	6 N.	13 E.	Rebecca Mg. & Mg. Co., 1608 Derby St., c/o Jos. S. Wright, Berkeley	65	
Recompence	22, 23 26, 27	4 N. 4 N.	13 E. 13 E.		40	R. XIV, p. 102
Red Gold						See Buckhorn Cons.
Red Hill	19	2 N.	14 E.	Edna L. McArdle, 344 W. Park St., Stockton; M. Annetta Fowler, Sonora	19	
Red Hill	30	3 N.	14 E.	A. L. Griffiths and Sam H. Hostetter Estate, 3134 Dale St., San Diego	21	
Red Top		3 N.	14 E.	S. B. Gardner, Murphys		R. XXI, p. 157
Red Wonder				W. L. Willmarth et al., c/o D. E. Hayes, 11½ Vincente Terrace, Santa Monica		
Reed & Hillary						See Lone Star
Reef Rock	13	3 N.	13 E.	Wm. M. Nuner, San Andreas	13	R. XIII, p. 116
Relief				H., Henry L., and Alvin Hogarth, c/o H. Hogarth, Box 262, Angels Camp	20	
Relief	14	2 N.	13 E.	Carson Hill Mng. Co., c/o L. Monte Verda, Angels Camp	7	R. XIII, p. 116; Bull. 18, p. 121; See also Carson Hill
Reserve	13	2 N.	13 E.	Carson Hill Mng. Co.	11	Bull. 108, pp. 133-134; See also Carson Hill
Returned & Golden Link	22, 23	4 N.	13 E.	C. W. Sanders, Angels Camp		
Rich Gulch	2	5 N.	12 E.	John C. Jens, R.F.D., Box 11, Mokelumne Hill	134	
Rindge Group	11, 12 13, 14 22, 23	5 N. 5 N. 5 N.	12 E. 12 E. 12 E.	Frederick H. Rindge, 708 Bank of America Bldg., Stockton	612	R. XXI, p. 157
Rio Vista	25, 26	2 N.	13 E.	Chas. Eugene Pioda, c/o Myrtle Wells Nock, Box 228, 447 California St., Stockton, and Rio Vista Mng. Co., c/o J. C. Duchow, Pres., Sonora	40	
Rising Star	19	2 N.	14 E.	Mrs. Mary A. McArdle, 344 W. Park St., Stockton		R. XI, p. 177
Rising Sun	19	2 N.	14 E.			R. XIII, p. 117
Ritter	27	5 N.	13 E.	Jupiter Mng. and Dev. Co.	7	R. XIV, p. 102; Bull. 18, p. 123
Riverside	5	6 N.	13 E.		40	R. XII, p. 96; XIII, p. 117; XIV, p. 102
Roanoke						See Moser
Rockingham	19	6 N.	13 E.	Clarence A. Berry, Valley Springs	20	R. XIV, p. 102
Rodesina						See Rose Hill
Rojas				Jesus Lopez, Esmeralda	20	
Romaggi & Costa	10, 11	2 N.	13 E.	Mrs. Louise C. Costa, Louisa Romaggi Estate et al., c/o Mrs. Jane Gazzolo, Oakland, or Mrs. C. De Martini, Carson Hill	19	
Rose Hill et al.	5, 8 25, 26	4 N. 5 N.	13 E. 13 E.	Emery Gold Mng. & Water Co., c/o F. J. Solinsky, Hobart Bldg., San Francisco	120	R. XI, p. 175; XIII, p. 117; XIV, p. 102
Rosella	3	1 N.	11 E.		20	R. XIV, p. 103
Royal	1	5 N.	11 E.	Preston Nuner, Mokelumne Hill		

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* To save space, frequently only one of several names is shown in this column.

TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Royal Cons.	19, 29 30 24	2 N. 2 N. 2 N.	12 E. 12 E. 11 E.	Royal Calaveras Mng. Co., c/o Alfred J. Harwood, Pres., 414-418 Kohl Bldg., Rm. 316, San Francisco	95	R. XI, p. 168; XIII, pp. 117-118; XIV, p. 103; XXI, p. 157; Bull. 18, pp. 126-127; U.S. Prof. Paper 157, p. 72
Ryland Cons.	20	3 N.	11 E.	Phillip S. Dean and Silas Dean, Milton	92	
Safe Deposit				Benson Mining Company		R. XI, p. 172; XII, pp. 96, 97; XIII, p. 118
Saltzer Group				Louis Saltzer, West Point		
Salvador et al.	5	5 N.	13 E.	Mae A. Clarke, 321 W. Flora St., Stockton	80	R. XIV, p. 103
San Andreas & Dorothy	17	4 N.	12 E.	B. T. Cannon, 18 E. S. Temple St., Salt Lake City		R. XIV, p. 104
San Antonio				Louise Greve et al., West Point		
San Antonio						See Lindsey
Sand Bar No. 1	12	6 N.	12 E.	Martin J. Fischer, c/o Rindge Mine, Mokelumne Hill, R.F.D.		
Sand Hill	29	3 N.	10 E.	T. H. Hunt, Jenny Lind	320	
Sand Hill	12	4 N.	9 E.	Annie Cavagnaro, Camanche	17	
Sand Hill No. 2 & Sugar Loaf P.	12	4 N.	9 E.	Samuel Lachenmaier, Shafter or Lodi	20	
Sandwich						See Collier
San Justo						See Carson Creek
San Pedro						See Rockingham
Santa Ana						See Pierano
Santa Cruz						See Calaveras Consolidated
Sarah L. & Harriet O.				Jos. S., and Jos. A. Wright, and M. O. Little, 1608 Derby St., Berkeley		
Sarah Q.	24	2 N.	12 E.	Chas. E. Longton et al., c/o C. K. Longton, 1109 38th St., Sacramento	24	
Satisfaction	7	4 N.	12 E.	M. J. Donnallan Estate, Wm. F. Ellis Estate, Annie L. Donnallan, Angels Camp	7	R. XIV, p. 104
Sawyer						See North Star
School House	11, 14	5 N.	12 E.	Willard A. Hughes, R.F.D., Mokelumne Hill	20	
Scorpion	11	8 N.	13 E.	Hilderbrandt, Posner & Co., Inc., c/o Richard Tum Suden, Suite 400, 605 Market St., San Francisco	11	R. XIV, p. 104
Searchlight	28	4 N.	12 E.	James Trengove, San Andreas	20	
Senora	10	2 N.	13 E.	Mrs. Louise C. Costa and Jas. M. Canepa, Angels Camp	3	
Seven Chute et al.				Carroll Evans, Lee O. Bray and D. E. Hayes, c/o D. E. Hayes, 1144 Yale St., Santa Monica		
Seven Spot				J. H. Lester and Dora M. Hibbard, R.F.D., Box Box 15 B, Mokelumne Hill		
Shaw	30	4 N.	14 E.		40	R. XIII, p. 119; XIV, p. 104
Sheep Ranch	7, 8 17, 18	4 N. 4 N.	14 E. 14 E.	Charles Martin Co., c/o L. Feusier, 1067 Green St., San Francisco	100	R. VI, pt. 2, p. 30; VIII, pp. 131-133; XI, pp. 175-176; XII, p. 96; XIII, p. 119; XIV, pp. 104-105; XIX, p. 17; XXI, pp. 158-159; Pre. Rep. 8, pp. 27-28; Bull. 18, pp. 104-105. Min. and Sci. Press, Vols. 29, 1874; 30, 1875; 36, 1878; 40, 1880; 91, 1905

Shenandoah	24, 33	5 N.	12 E.	M. Gattavara and Edw. Shopbell, Mountain Ranch, and J. S. Jack, San Andreas		R. XI, p. 176; XII, pp. 96-97; XIII, p. 119; XIV, pp. 105-106
Sherman Ranch						R. XXI, p. 159
Sheridan						R. XII, p. 97; XIII, p. 119
Shirley Queen	18	1 N.	12 E.	Ducommun & Germain, c/o Chas. A. Ducommun, Box 310, Arcade Sta., Los Angeles	20	
Shotgun	15, 16	3 N.	12 E.	Julia J. Waters, San Andreas	21	R. XIV, p. 106; Bull. 108, p. 147
Silver Mountain						R. XIII, p. 119
Silver Shield No. 1, No. 2, Twin Top No. 1, No. 2				Mrs. P. C. Martz, P.O. Box 1087, Angels Camp		
Single Standard						R. XIII, p. 119
Slate Creek	6	3 N.	11 E.			R. XIII, pp. 119-120
Smith & Crooks	11	2 N.	13 E.	Norman Smith, 4227 14th Ave., Sacramento, et al.	5	R. XIV, p. 106
Smythe	30	3 N.	13 E.		20	R. XIII, p. 120; XIV, p. 106
Soap Root	11	6 N.	12 E.		5	R. XIV, p. 106
Sonoma	30	4 N.	14 E.	F. Hewlett, Cora Blackden et al., c/o Mrs. Blackden, 3623 Sacramento Blvd., Sacramento	20	R. XIV, p. 106
South African	36	5 N.	11 E.		20	R. XIV, p. 106
South Bank	21	4 N.	14 E.	Clary Gold Mining Co., c/o Frank A. Kent, Sec., Box 220, Stockton	8	R. XIV, p. 106
South Carolina						See Carson
South Paloma	27, 28	5 N.	11 E.	H. J. and R. V. McSorley, Mokelumne Hill, and Henry W. Sieleman, Valley Springs	16	R. XIII, p. 120
Sparrow Hawk	2	5 N.	12 E.	John C. Jens, Belmont		
Specimen	3	3 N.	12 E.	C. R. Peters et al., 116 Gramercy Park, Players Club, New York	14	
Spring Day	19	6 N.	13 E.	Eva P. Lund, Mokelumne Hill	20	R. XIV, p. 107
Spring Gulch	35	7 N.	13 E.		20	R. XIII, p. 120; XIV, p. 107
Spring Gulch Gold Mng. Co.	1	4 N.	11 E.	c/o J. S. White, 148 Ronado Ave., Piedmont	40	
Spring Gulch Cons.	10, 14	2 N.	13 E.	George E. Stickle, Angels Camp	46	
Spring Valley	8	4 N.	11 E.	Theresa Rooney vs. Mrs. S. S. W. Phelps, c/o Mary Jane Rooney, 1775 N St., Washington, D. C.	240	
Squire Boyd	21	3 N.	14 E.	Warren N. Garland, Oakdale	20	
Stand By	NE. ¼, 35	6 N.	13 E.	L. B. Fish, Railroad Flat	15	R. XXI, p. 153
Standard Group	18	6 N.	14 E.		100	R. XIV, p. 108
Stanislaus						See Melones
Star	3	2 N.	13 E.	Nellie Cencevich, Joe Dixie and Russell Gold Mng. Co., Angels Camp		
Star & Excelsior	23, 24 25, 26	1 N. 1 N.	11 E. 11 E.	Wm. M. Nuner, San Andreas	17	R. XIV, p. 62
Star of India Cons.	5 31, 32	2 N. 3 N.	13 E. 13 E.	Thos. E. Byrnes, E. A. Husing, Ethel I. Cahalan, et al., 808 Laurel Ave., San Mateo	56	R. XIII, p. 120
Starlight	17	4 N.	13 E.		160	R. XIII, p. 120; XIV, p. 107
Star of the West	26	7 N.	13 E.	Chas. Harker, 1212 Humboldt Bank Bldg., San Francisco; Jas. Irvine, Jr., et al., Suite 818, Bank of Italy Bldg., Los Angeles	21	R. XIV, p. 107; XXI, pp. 151-152
Stars & Stripes						R. XIII, p. 120
Steger	5	6 N.	13 E.		27	R. XIV, p. 108; R. XVIII, p. 21
Stickles						See Utica-Stickles
St. Lawrence						See Bruner

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*To save space, frequently only one of several names is shown in this column.

TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Stonewall	7	3 N.	14 E.	Geo. S. Taylor, Murphys, and Mrs. Justine Potter, c/o Mary Batten, Murphys	20	R. XIII, p. 120
Stonewall Jackson				Thomas C. Woodcock, Glencoe		R. XIV, p. 109
Storm King	3	2 N.	13 E.	Domingo Rolleri et al., c/o George B. Bennett, Angels Camp	4	
Suffolk						See Brown, Smythe and Ryland
Sulphur Spring	4	2 N.	14 E.	Roy Sperry and Carey Mitchell, Wesley		
Sultana	34	3 N.	13 E.		20	R. XIV, p. 108; Bull. 108, pp. 147-148
Summit	11	5 N.	13 E.		20	R. XIV, p. 108
Sunbeam				John Gow, c/o Ralph Parks, Central Bank Bldg., Oakland		
Sunlight	17, 21	4 N.	13 E.	G. McM. Ross Estate and Benj. Johnston, c/o B. Johnston, Box 161, Jackson	170	
Sunrise	34	4 N.	13 E.	Estate of F. Davis, c/o Lillian Parks Davis, 2872 Jackson St., San Francisco	9	R. XIV, p. 108
Sunrise	30, 31	3 N.	14 E.		28	R. XIV, pp. 108-109
Swindlehurst						See Harrison
Swiss	29	6 N.	14 E.	Agnes Wood, c/o J. D. Wood, 2118 Hearst Ave., Berkeley, or Title Insurance Bldg., 4th and Spring Sts., Los Angeles	18	R. XIV, p. 109
Table Mountain	3	4 N.	13 E.	Annie M. Raggio, Angels Camp, and A. L. Wyllie, Campo Seco	21	
Table Mountain Ranch	1	4 N.	13 E.	California Trust Co., 629 S. Spring St., Los Angeles	15	
Tanger	25 30	6 N. 6 N.	12 E. 13 E.	Louis Lacaille, Railroad Flat	19	
Tanner	32	4 N.	14 E.		41	R. XIV, p. 109; XVIII, p. 98
Tarr				Lynch & Bolitha Mng. & Milling Co., c/o Austin Lynch, Rms. 1-5 Schaefer Block, Canton, Ohio		
Texas	5	6 N.	13 E.	Mrs. Bertha Davidson et al., c/o Mrs. C. Randell, 33 Craig Ave., Piedmont, and L. S. Davidson, Rm. 601, 154 Sutter St., San Francisco	10	
Texas & Missouri	17	3 N.	14 E.	John Grenitta, Box D, Murphys	16	
Texas	11	4 N.	10 E.	Jennie Blalock, 810 Linden Drive, Beverly Hills		
Thorne						Bull. 108, p. 148
Thorpe	11	3 N.	12 E.	Thorpe Mng. Co., 660 Sacramento St., San Francisco		R. X, p. 63; XIII, p. 121; XIV, p. 109; Bull. 108, p. 143
Three Brothers	11	2 N.	13 E.	Jos. E., John Romaggi et al., c/o James Romaggi, Angels Camp	4	
Three Clover				Chas. Blount, Mountain Ranch, and Ed. B. Keen, Mountain Ranch		
Three Clover Ext.				Ed. E. Esplen and W. H. Hinderliter, 3133 N. San Joaquin St., Stockton		

Tiger						See Ilex
Tilford						R. XIII, p. 121
Tiro	11	1 N.	12 E.	Lurie Drew Copp and R. L. Gardner, c/o R. L. Gardner, 1246 Sacramento St., San Francisco	23	
Tollgate	29	3 N.	13 E.		35	R. XI, p. 171; XIII, p. 116; XIV, p. 101; XXI, pp. 159-160; Pre. Rep. No. 8, p. 28; Bull. 108, p. 148
Tom	30	3 N.	13 E.	Benson Mining Co.	8	
Tom Boy	18, 19 30	5 N. 5 N.	12 E. 12 E.	Tom Boy Gold Mines Co. (a corp.), Mokelumne Hill	24	
Tom Smith	7	4 N.	14 E.	Charles P. Snyder, San Andreas		R. XIV, p. 110
Top Notch				E. H. and M. L. Green, Esmeralda		
Total Wreck	6	3 N.	14 E.	Charles P. Snyder, San Andreas		R. XIII, p. 121
Tough Nut	32	3 N.	10 E.	Mark J. B. Belloni	11	
Toyon Nos. 1 to 5				C. A. Riley, Angels Camp		
Tracy	2	2 N.	13 E.	George E. Stickle, Angels Camp		
Treasure Vault	1	3 N.	13 E.	Gail B. Bulmer, 203 Ralston St., Reno, Nevada, and V. A. Tamney, c/o Thos. E. Denslow, Murphys		
Triple E.				Edward E. Esplen and C. C. Carner, 3133 N. San Joaquin St., Stockton		
Triple Lode	32	3 N.	13 E.	J. B. Demaria and Jos. Gianera	53	R. XI, p. 172; XII, pp. 90, 97; XIII, p. 98; XIV, p. 70; XVIII, p. 98; XIX, p. 18; XXI, p. 160; Pre. Rep. 8, pp. 28-29; Bull. 108, pp. 148-149
Tripp						See Gardner Cons.
Trojan & N. Trojan						R. XII, p. 98
Tryon	33, 34	3 N.	13 E.		20	R. X, pp. 129-31; XIII, p. 121; XIV, p. 110
Tryon Mng. Co.	3	2 N.	13 E.	c/o C. W. Tryon, Angels	10	
Tulloch	11	2 N.	13 E.	Estate of James Tulloch, Mrs. Lillie Bisbee, Mrs. Emma Sell, and Mrs. Sell, Sonora	10	R. X, pp. 59, 151; XI, p. 171; XII, p. 98; XIII, p. 121; XIV, p. 110; XXI, p. 160; Bull. 18, p. 121; Bull. 108, p. 149
Twin Oak et al.				Twin Oaks Mining Co., c/o Dr. R. B. Griffenhagen, Box 845, Fresno		
Twin Tree	23	2 N.	13 E.	F. G. Stevenot, 2350 Cecilia St., San Francisco, et al.	20	
Unexpected & Expected No.	15	5 N.	11 E.	Thos. J. Tynan, 547 Frederick St., San Francisco		
Union	13, 14	2 N.	13 E.	Carson Hill Gold Mng. Co.	4	See Carson Hill
Union Cordova & Burgess Group et al.	28, 33 3 4 27	4 N. 4 N. 3 N. 4 N.	12 E. 12 E. 12 E. 12 E.	Albert Guttinger, San Andreas	94	R. VIII, p. 147; X, p. 63; XIV, p. 110; Bull. 108, p. 147. Eng. & Min. Jour.-Press, Vol. 130, p. 530. Trans. A.T.M.E., 1901. Min. Res. W. of Rocky Mts., 1870, pp. 30-31. U.S. Geol. Surv., Prof. Pap. 157, p. 71
Union Cons. Mng. Co.				c/o F. O. Proctor, Murphys	38	
Union Mines, Inc.	23	5 N.	11 E.	Union Mines, Inc., c/o Carroll Holmes, 4427 Victoria Park Drive, Los Angeles	160	
Uno						See Empire Consolidated
Utica	33	3 N.	13 E.	Hobart Estate Co., and Emma, Rose, 351 California St., San Francisco		R. VI, pt. 2, pp. 28-29; VIII, pp. 122-126; X, pp. 150-151; XI, p. 171; XII, pp. 98-99; XIII, pp. 121-122; XIV, pp. 110-112; Bull. 18, pp. 111-119; Bull. 108, pp. 149-151

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TABLE OF QUARTZ MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Utica No. 2 et al.	30	3 N.	13 E.	Cerolomeo Guisto, Altaville		
Valentine, Jr.				James V. Coleman, Jr., 148 Montgomery St., San Francisco		See Angels Mine
Valentine et al.	19, 20 30	6 N. 6 N.	13 E. 13 E.	The Haslett Warehouse Co., a corp., as trustee, 280 Battery St., San Francisco	82	
Virginia				Adolph B. Becker, Box 18, Altaville, and Wm. T. McFall, Altaville		
Voinich						R. XIV, p. 112
Wagon Rut	32	3 N.	13 E.	Violet Miller, Hotel Thomas, 971 Mission St., San Francisco	8	
Wash & Libble & Red Star	7, 18	1 N.	13 E.	M. Elsasser Estate, 111 W. 7th St., Los Angeles	26	
War Eagle				Mrs. Nellie Cencevich et al., Angels Camp	4	
Washington	20, 21	4 N.	14 E.			R. XII, p. 99; XIII, p. 122; XIV, pp. 73, 112; XVIII, p. 98; XIX, p. 17; XX, pp. 4-5, 178; XXI, pp. 160-161; Pre. Rep. 8, pp. 25-26
Water Lily	2	6 N.	13 E.	B. F. Porter Estate, c/o W. T. Sesnon, Holbrook Bldg., San Francisco	21	R. VIII, p. 141; XII, p. 90; XIII, p. 122; XIV, p. 112
Waterman	3	2 N.	13 E.			Bull. 108, p. 151
Watson	32	2 N.	12 E.	J. B. Watson et al., c/o Ben Berry, First Nat'l Bank, Stockton	21	
Webster	18	1 N.	13 E.	Ida L. Connolly, 1630 N. Hunter St., Stockton, Alice K. Shaw, Fort Sill, Oklahoma et al.	40	
West Extension				R. F. McKisson, R.F.D., Mokelumne Hill		
Western	20	4 N.	14 E.	Bert R. Deleray, 420 S. San Pedro St., Los Angeles	21	
Western & Gold Wedge				John Casey, Mokelumne Hill		
Western Star	33 4	3 N. 2 N.	13 E. 13 E.	Giacomo Oneto, Angels Camp	18	
West Point Cons.	5 29, 32	6 N. 7 N.	13 E. 13 E.	West Point Cons. Mines, Inc., c/o E. H. Outerbridge, 250 Park Ave., New York	174	
Wet Gulch Q. & P.	27, 28	6 N.	13 E.	Isabella Pike, c/o D. A. Pike, 3352 Clay St., San Francisco	86	R. XIV, p. 123
Wet Gulch, Hope & Hope Extension				T. P. Shufelton, 418 Turk St., San Francisco		
White				B. Mondana, Glencoe		
White Elephant	5	5 N.	14 E.	Louis G. Guillemin, Mist		
White Pine	8, 9	3 N.	14 E.	Alex M. McQuig, c/o Geo. Stannard, 5548 Holway St., Oakland or Carson Hill	19	
White Swan	15	5 N.	11 E.	Annie M. Raggio, Angels Camp		
Wickham & Buhlert	1	6 N.	13 E.	Walter R. Wickham, 3305 Elm St., Oakland, or Mayhew Station	140	
Wide West	2	6 N.	13 E.	Wm. Wertch and B. L. A. Harker, c/o O. F. and H. M. Anthony, Humboldt Bank Bldg., San Francisco		R. XXI, pp. 151-52

Wheelock	23	4 N.	13 E.	Jas. G. Berryhil,, 304 New Call Bldg., San Francisco		R. XIII, p. 123; XIV, p. 112
White Oak						R. XIII, p. 123
White Oak	10	2 N.	13 E.	Joseph M. Canepa, Box 286, Angels		
Whittel						R. XII, p. 99; XIII, p. 123; XIV, p. 113
Wide Awake						R. XIV, p. 113
Widow						See Etna King
Wilbur Womble, Homestead & Boston	28, 32	2 N.	12 E.	Louis Cereghino, Chas. W. Rebmann, Richard A. Ford, Fred Seitz, c/o Fred Seitz, 4492 Mission St., San Francisco	500	R. XIV, p. 113; XXI, pp. 153-154
Wild Goose	17	3 N.	14 E.	Herbert Davies and Charlotte Davies, Douglas Flat	6	
Wild Rose				A. D. Hash, West Point		
Wiley						See Leonard
William R., Last Chance & Bulger Cons., Magee & Hodson Cons.	19, 24	2 N.	12 E.	Robert B. Parks, 130 E. Walnut St., Stockton	53	
	30	2 N.	12 E.			
Wolverine	21	6 N.	13 E.	Lillie Taylor, 435 E. Polk St., Stockton, et al.		R. XIV, p. 114; Min. Res. W. of Rocky Mts., 1872
Woodhouse, Gilded Age & Development	8, 17	6 N.	13 E.	Woodhouse Mng. Co., a corp., c/o W. W. Gibson, West Point	106	R. XIV, p. 114; XVIII, p. 21; XX, p. 76; Reg. of Mines, Calaveras Co., p. 16
Woodstock						See Mount Ophir
Wyllie	16	4 N.	11 E.		40	R. X, pp. 151-152; XIII, p. 110
	7, 8	4 N.	12 E.			
Yellow Pine	6	2 N.	11 E.			R. XIII, p. 123
Yellowstone	30	3 N.	13 E.	Benson Mining Co.	19	R. XI, p. 173; XII, p. 97; XIII, p. 123
Yellow Wing				Martin Markwood, Valley Spring		
Young America	14	3 N.	14 E.	Manuel Estate Co., c/o Matt Manuel, Murphys	16	R. XIII, p. 123
Ziegler & No. End						See Etna King

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GOLD PLACER MINES

Ancient Shore-line Deposits.

A great deal of the placer-mining begun in the county during the past three years has been confined to exploitation of the delta and shore-gravels along the former eastern border of the Ione sea, extending along the entire west side of the county. Previously, much work had been done with bucket dredgers, at Jenny Lind and near Camanche.

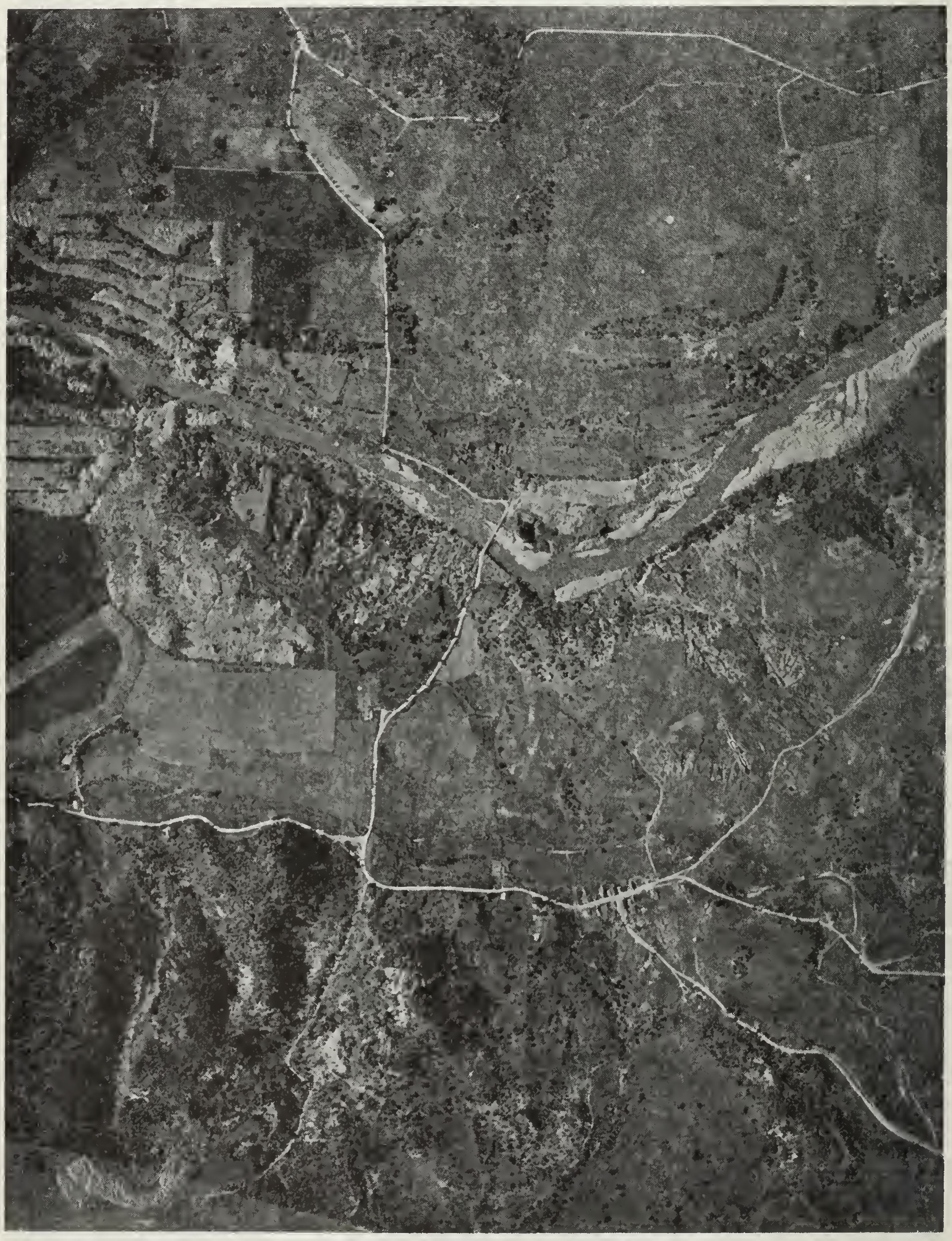

Fig. 13. Vertical air-view of Mokelumne River basin near Camanche. The village of Camanche is south of bend in river. This area is now the scene of considerable activity for dredges and dragline equipment which are mining the auriferous gravels.

Photo by courtesy of Russell Aero-Photos.

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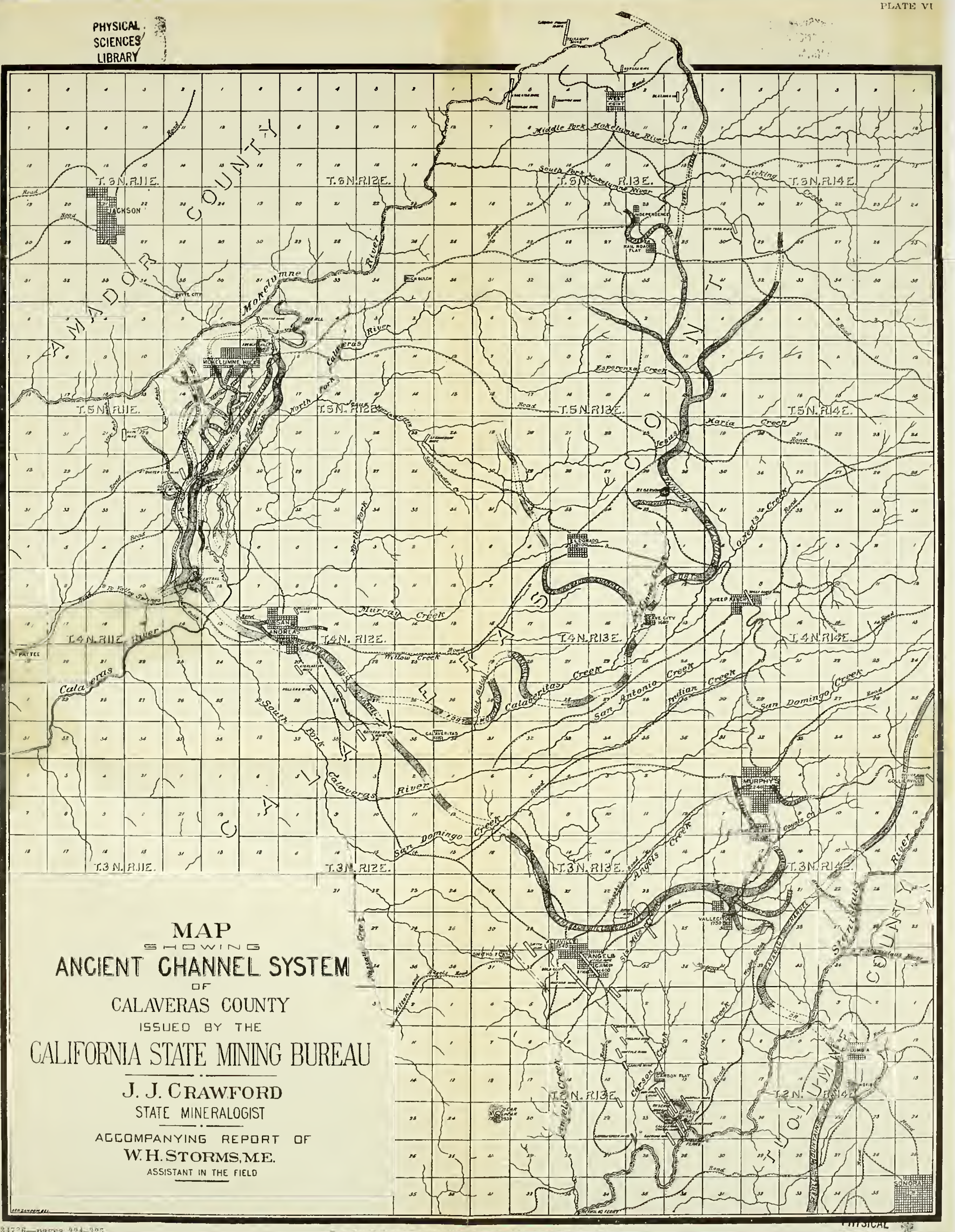
AMADOR COUNTY
CALAVERAS COUNTY
TUOLUMNE COUNTY
T.6N.R.11E.
T.6N.R.12E.
T.6N. R.13E.
T.6N.R.14E.
T.5N.R.11E.
T.5N. R.12E.
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T.4N.R.11E.
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T.4N.R.13E.
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T.3N.R.12E.
T.3N.R.13E.
T.3N.R.14E.
T.2N.R.13E.
T.2N.R.14E.
JACKSON
MOKELUMNE HILL
SAN ANDREAS
EL DORADO
CAVE CITY
SHEEP RANCH
MURPHYS
VALLECITO
ANGELS
ALTAVILLE
COLUMBIA
SONORA
COLLIERVILLE
CALAVERITAS
CARSON FLAT
RAIL ROAD FLAT
INDEPENDENCE
RICH GULCH
BUTTE CITY
PATTEE
SMITHS FLAT
Middle Fork Mokelumne River
South Fork Mokelumne River
Mokelumne River
Licking Creek
North Fork Calaveras River
South Fork Calaveras River
Calaveras River
Esperenza Creek
Jesus Maria Creek
Maria Creek
O'Neal's Creek
Murray Creek
Willow Creek
Calaveritas Creek
San Antonio Creek
Indian Creek
San Domingo Creek
Angels Creek
Coyote Cr.
Coyote Creek
Carson Creek
Six Mile Creek
Stanislaus River
Salamander C.
Old Gulch
Road
To Valley Springs

MAP
SHOWING
ANCIENT CHANNEL SYSTEM
OF
CALAVERAS COUNTY
ISSUED BY THE
CALIFORNIA STATE MINING BUREAU

J. J. CRAWFORD
STATE MINERALOGIST

ACCOMPANYING REPORT OF
W. H. STORMS, M.E.
ASSISTANT IN THE FIELD

Reprinted from Report XII of State Mineralogist, p. 482.

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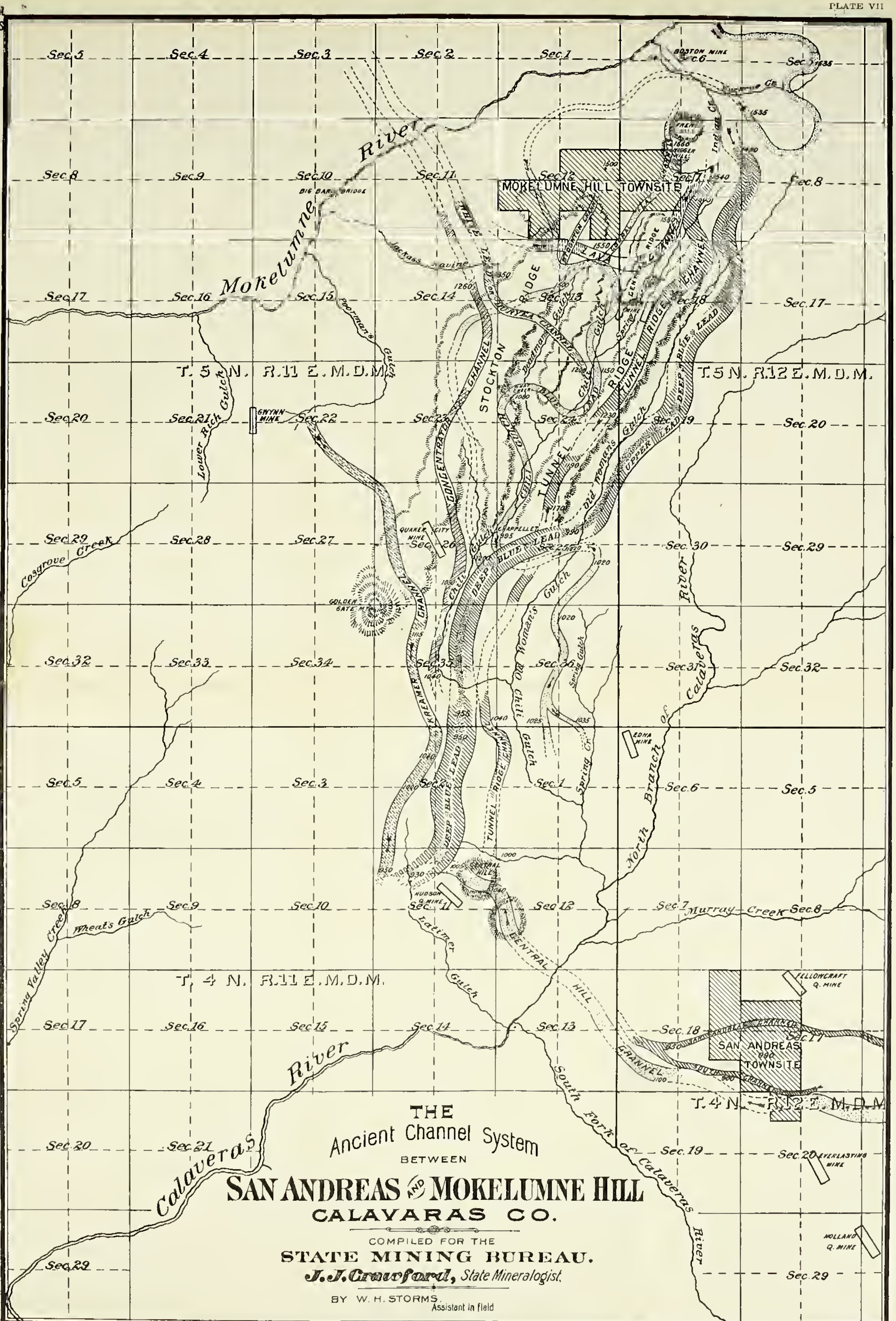
Sec.5
Sec.4
Sec.3
Sec.2
Sec.1
Boston Mine
Sec.6
Sec.8
Sec.9
Sec.10
Big Bar Bridge
Sec.11
Sec.12
Sec.7
Sec.8
Mokelumne Hill Townsite
Mokelumne River
Jackass Ravine
Sec.17
Sec.16
Sec.15
Sec.14
Sec.13
Sec.18
Sec.17
Poorman's Gulch
T. 5 N. R.11 E. M.D.M.
T.5 N. R.12 E. M.D.M.
Sec.20
Sec.21
Lower Rich Gulch
Gwynn Mine
Sec.22
Sec.23
Sec.24
Sec.19
Sec.20
Stockton Ridge
Concentrated Channel
Lava
Tunnel Ridge
Deep Blue Lead
Upper Lead
Old Womans Gulch
Chili Gulch
Sec.29
Cosgrove Creek
Sec.28
Sec.27
Quaker City Mine
Sec.26
Sec.25
Sec.30
Sec.29
Golden Gate Mt.
Old Woman's Gulch
Sec.32
Sec.33
Sec.34
Sec.35
Sec.36
Sec.31
Sec.32
Old Chili Gulch
Spring Gulch
Kreamer Channel
Edna Mine
Sec.5
Sec.4
Sec.3
Sec.2
Sec.1
Spring Cr.
Sec.6
Sec.5
Deep Blue Lead
Tunnel Ridge Channel
North Branch of Calaveras River
Central Hill
Hudson Mine
Sec.8
Sec.9
Sec.10
Sec.11
Sec.12
Sec.7
Murray Creek
Sec.8
Wheat's Gulch
Spring Valley Creek
Latimer Gulch
Central Hill Channel
T. 4 N. R.11 E. M.D.M.
Fellowcraft Q. Mine
Sec.17
Sec.16
Sec.15
Sec.14
Sec.13
Sec.18
Sec.17
San Andreas Townsite
T.4 N. R.12 E. M.D.M.
Calaveras River
South Fork of Calaveras River
Sec.20
Sec.21
Sec.19
Sec.20
Everlasting Mine
Holland Q. Mine
Sec.29
Sec.29

THE
Ancient Channel System
BETWEEN
SAN ANDREAS AND MOKELUMNE HILL
CALAVARAS CO.
COMPILED FOR THE
STATE MINING BUREAU.
J. J. Crawford, State Mineralogist.
BY W. H. STORMS.
Assistant in field

Reprinted from Report XII of State Mineralogist, p. 486.

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The increased price of gold, and the successful application of drag-line outfits and small gravel-washing plants in other districts has resulted in the erection of similar equipment here to work small areas of placer ground.

The Ione sea received the sand and gravel from the rivers then draining the gold-bearing region to the east. Ancient channels entered this sea near Jenny Lind and a little north of Valley Spring, the latter supplying gold to the Lancha Plana-Camanche section from the Mokelumne Hill and Central Hill districts, famous in the past for their rich gravel mines. These shore-gravels have in places been dissected or partly covered by later gravel or andesite, and further eroded by modern streams since the uplifting of the country. Their geology is therefore likely to be found complex. Experience in other districts where similar deposits have been worked, show that small acreages may be profitably worked if the gravel is loose, not too deep, and is underlain by material soft enough to dig with drag-lines or mechanical shovels.

Ancient Channel Systems.

In pioneer days, Mokelumne Hill was one of the noted placer-mining camps and a tremendous amount of drift mining was done there. In the past 20 years and until recently, there has been little production from this section, and attention has been given by operators principally to the Central Hill channel system from Vallecito west and northwest to San Domingo Creek, north of Altaville. Two producing mines have been in operation several years and other properties are being opened. The Central Hill channel system lies below the present drainage in the region mentioned, so that the deposits must be worked through shafts, and water must be pumped.

Of late, there has been a marked renewal of drift mining in all parts of the county where buried channels occur, and production has begun in a small way at several places, as mentioned in Franke's notes herein.

An article entitled ''Ancient Channel System of Calaveras County,'' by Wm. H. Storms, was published in Report XII of the State Mineralogist, 1894. It was accompanied by two maps, one showing in detail the channels near Mokelumne Hill and the other depicting the main ancient-river courses of the county. This report having been out of print for some years, and there being frequent calls for these maps, they are reproduced herewith. Later reports, such as Bulletin 92, ''Gold Placers of California,'' which summarizes this information, and the descriptions of individual mines in the county chapters published since 1914, will be found informative.

The Fort Mountain channel system extends southward through the county from West Point nearly to Sheep Ranch then turns west toward San Andreas, joining the Central Hill channel about three miles southeast of that town. These channels, believed to be Tertiary courses of two branches of Calaveras River, flowed northwest to Central Hill, six miles beyond their junction; there the stream is presumed to have joined the southward-flowing river system from Mokelumne Hill. The mining revival has also resulted in renewed prospecting on the Fort Mountain channel and its tributary, the El Dorado channel, which joins it near Cave City.

Atlas Gold Dredging Corporation has leased 240 acres of auriferous gravel land owned by the *Calaveras Gold Dredging Company,* in Sec. 14, T. 4 N., R. 9 E., 1 mile southwest of Camanche. Frank E. Ford is president, and W. E. Moffett, secretary, of the Atlas Gold Dredging Corp., 617 Edison Bldg., Los Angeles. J. E. Little is vice president and general manager of operations.

Sampling of the property commenced in October, 1935, and construction of the drag-line dredge began in December, 1935. Four million cubic yards of Ione shoreline gravels, from 12 to 25 ft. thick, are estimated to be available. The gravel is tight, but not cemented. No large boulders occur. It has a volcanic ash bedrock. The gold is fine, and will probably average 25¢ per cubic yard.

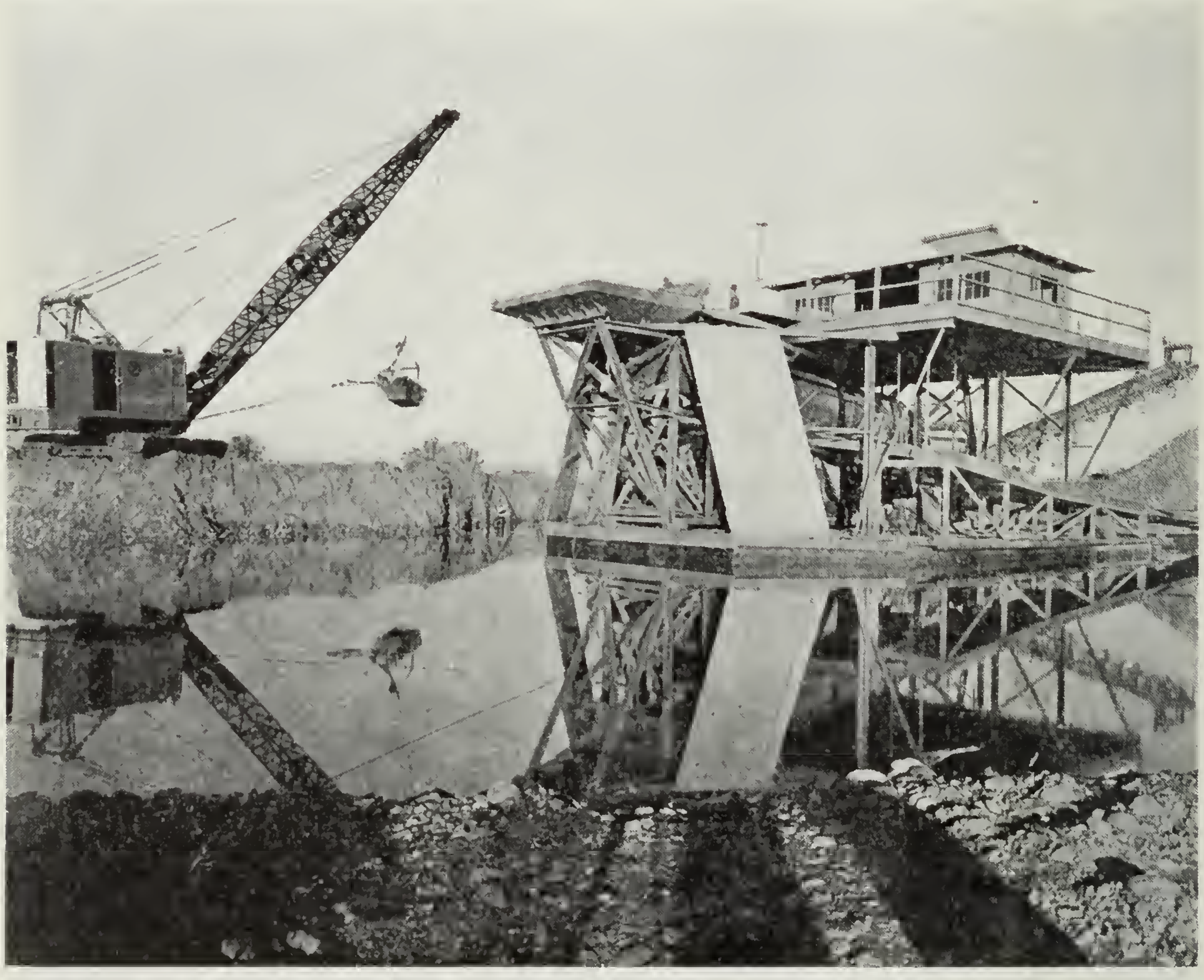

Fig. 14. Dragline and washing equipment of Atlas Gold Dredging Corporation at Camanche.

Photo by courtesy of Pacific Gas & Electric Co.

A K-55 Link Belt electric dragline, with 2-cu. yd. bucket, is used to mine the gravel. The steel-frame washing plant, mounted on a floating hull, consists of a hopper, 33½ ft. by 60-inch Bodinson trommel, electrically driven, and about 712 sq. ft. of sluice lined with Hungarian riffles. A 10-inch Byron Jackson pump supplies water to the 13½ ft. of scrubbing section. The tailings stacker consists of a 70-ft. belt conveyor. The wooden hull is 43 inches deep by 39 ft. wide by 50 ft. long. The plant is designed to handle 3,000 to 4,000 cubic yards a day. Production commenced early in 1936.

Balaklava, or I. X. L. Mine, is in Sec. 32, T. 3 N., R. 14 E., about 3 miles by road south of Vallecito. This placer property, consisting of 80 acres, is owned by Roy Nesbitt, Bell, California. It is said to be on the Cataract channel. Development includes an old 400-ft. inclined (27°) shaft, with a level at 375 ft., from which there is an old drift, said to run about 100 ft. southwest. Idle.

Balaklava No. 2 Placer Mine, adjoining the I. X. L. or Balaklava, in Sec. 32, T. 3 N., R. 14 E., about 3 miles by road south of Vallecito, is owned by Charles Tryon, Angels Camp. It was operated a few years ago, but all workings are now said to have caved.

Barn (Corral Flat) Mine, in the southern part of the townsite of Mokelumne Hill, is owned by C. G. Nuner, Mokelumne Hill. E. S. Jackson and B. J. Webb leased and commenced working the mine in March, 1936. It is on the Corral Flat channel which courses southwestward. Portions of the gravel are cemented, and many boulders are found in the channel. Development includes a 160-ft. vertical shaft from the bottom of which a 40-ft. crosscut has been driven northward to the channel. A 100-ft. drift has been completed northeast up the channel. At present the gravel is 40 ft. in width and about 12 ft. in depth. Gold is found in the bottom 3 ft. of gravel and on bedrock. The gravel is said to average better than $1.50 a cubic yard. There are some old caved workings in this mine which are said to connect with the *Tunnel (Nuner) Mine,* on the west side of Stockton Ridge. Equipment includes an electric hoist, pump driven by electric motor, gravel bin, trommel and sluice. The mine makes enough water for sluicing. Three men are employed. Only 6 tons of gravel is now washed daily.

Batten Ranch, in Sec. 20, T. 3 N., R. 14 E., ½ mile north of Vallecito, was last prospected by Gordon Scheckler of Stockton. An old inclined shaft was deepened until it struck gravel at 400 ft. A 100-ft. crosscut was then driven, mostly through altered granite, but the gravel channel was never found.

Blue Gravel Mine, adjoining the Casinelli mine to the north, 6 miles by road northwest of San Andreas, is thought to be on the Deep Blue Lead Channel. Sixty acres of the 120-acre holding is owned by the present operators, W. F. Talmadge and George A. Hill, Box 134, San Andreas, who commenced working the property in the winter of 1931. Workings include a 115-ft. vertical shaft through lava capping and gravel to slate bedrock. A 160-ft. drift was driven westward, from which point about 250 ft. of drifting was done northwestward. The main channel is believed to lie farther west. A crosscut was being driven northward through slate, in hopes of encountering a tributary to the main channel, which is thought to have been partly developed by the old caved workings. Equipment includes a Sampson hoist and air compressor, driven by a Continental fuel-oil engine. The washing plant consists of a 20-ft. trommel, and a 60-ft. sluice lined with wooden riffles. Three men are engaged in the prospecting work.

Boire Placer Mine, ¼ mile east of Railroad Flat, has been operated off and on since April, 1932, by Walter Reichling, Railroad Flat. E. Maree, Jackson, owns the property. The mine is located on a bend in the channel, said to be the Fort Mountain or Blue Lead channel. It has been developed by a 200-ft. inclined shaft, sunk through a rhyolite tuff capping. The gravel is loose, and said to average $1.50 a cu. yd. The gold is very fine, and is accompanied by considerable black sand. There are some boulders. Bedrock is slate. The small amount of water drains from the mine through old workings. The present operators have drifted northward, up the trough of the channel for about 400 ft. The washing plant consists of a concrete mixer, and a 20-ft. sluice with Hungarian riffles and screen. The ½-ton capacity skip is hauled up by a gasoline-engine-driven hoist. Two men are employed.

Boundary Cone Mine, in Sec. 19, T. 5 N., R. 12 E., 3 miles by road south of Mokelumne Hill, is on the Deep Blue Lead Channel, also known as the North Star and Old Woman's Gulch Channel. The *Minnath Mining Company,* a closed trust, P. O. Box 131, San Andreas, leased this 240-acre property from the owners, *Tom Boy Gold Mines Company,* a Nevada corporation, with offices at 921 Stock Exchange Building, Los Angeles. Their operations commenced in December, 1932. E. H. Brooks is manager.

The channel courses southwest. The compacted gravel is found to a depth of 15 ft., approximately 100 ft. in width. The gold, about 900 in fineness, varies from $1.20 to $9.00 a cu. yd. The present operators are still prospecting the channel and have done very little breasting. The 386-ft. inclined (22°) shaft has been driven through interbedded gravels and lava to bedrock, which is Calaveras schist. A 650-ft. northeastward drift has been driven upstream from near the end of a 1700-ft. drift north of the shaft. A fault was encountered in the 650-ft. drift, and it was necessary to drive a raise in order to remain on the floor of the channel. A Byron Jackson centrifugal pump, driven by an electric motor, is used to pump the 90 gallons of water a minute that the mine makes.

A separate underground chute for waste and gravel at bottom of shaft is used to load the 14-cu. ft. capacity mine cars, which are hauled up the incline by means of an electric hoist. From the collar of the shaft, the cars are trammed 150 ft. to the gravel bin. The washing plant consists of a 3 by 11-ft. trommel, with a 100-ft. sluice lined with Hungarian riffles. There is also a 118-cu. ft. Gardner-Denver air compressor, driven by an electric motor. A total of 15 men are employed for two shifts.

Buck Brothers Mine, also known as *Chapman* or *Plug Ugly Mine,* is located 1½ miles southeast of San Andreas. One-half interest in the mine is held by Josephine Chapman Keasal, Tacoma, Washington, and Hattie H. Chapman Gibbs, San Francisco; the other half interest by J. A. Smith, San Andreas. Clarence C. Buck, Box 181, San Andreas, now has the property leased and is superintending operations, which commenced in September, 1934.

It is on the Fort Mountain Channel, which courses N. 40° W. on this property. The channel is being developed through an old 210-ft. inclined (78°) shaft. At the time of visit, December, 1935, a drift had been run down the channel N. 40° W. for a distance of 60 ft. on the 174-ft. level. Other development on this level includes a 120-ft. drift southeast and a 200-ft. drift northwest. The Mariposa slate bedrock is somewhat smooth and most of the gold is found in the cemented gravel. One foot of bedrock and 10 ft. of gravel are mined and milled. The present pay gravel is 20 ft. wide. The gravel is well rounded, and consists of quartz, slate, yellow 'niggerheads,' and white granite. Large boulders occur. The cemented gravel is overlain by a gray lava capping.

The mine is drained by an old 400-ft. drift from the 200-ft. level. A No. 7 Hooker pump handles the 150 gallons of water per minute. All of the mine is timbered.

A tugger hoist hauls the gravel in $\frac{3}{4}$-yard cars up a 7° incline for 60 ft. to the shaft bin, whence the gravel is delivered to a 50-yard surface ore-bin by $\frac{1}{2}$-yard skip. The washing plant consists of a 16 ft. by 30-inch trommel, 50 ft. of riffled sluice, and 300 ft. of flume for tailings disposal. A gasoline engine is used to operate the trommel. From 11 to 28 cubic yards were being washed daily. Gold of medium size, with a trace of silver (882.5 fine) is being produced.

Other equipment includes: gasoline-engine hoist, 220-cu. ft. Sullivan compressor, and a blower. Sixteen men were employed one shift, 5 working underground.

The trommel mentioned above is to be replaced by a new Bodinson trommel because some of the cemented gravel is not being thoroughly disintegrated. A new exploration tunnel has also been started downstream (May, 1936).

Buffalo What-Cheer Mines, Ltd., 606 So. Hill Street, Los Angeles, commenced working the *Buffalo* and *What-Cheer mines,* consisting of 540 acres, on August 26, 1935. The *Mokelumne Mines, Ltd.*, unwatered these old properties prior to the present operation, but did nothing further. The present operating company consists of Los Angeles and Honolulu interests, headed by H. B. Menardi of Los Angeles. Clayton Chatfield is superintendent.

The mine is about $2\frac{1}{2}$ miles south of Mokelumne Hill, on the Chili Gulch Deep Blue Lead Channel. The channel makes a bend at this point, but in general courses south. The gravel is slightly cemented. The bedrock consists of mineralized slate, which is of little value. Development includes a 300-ft. vertical shaft through basalt lava-capping and slate. A 550-ft. drift had been driven north on the east rim through slate, from which point a winze was being sunk to the bottom of the channel. The small amount of development completed by December, 1935, showed that the rim gravel contained gold in fine sizes, with considerable black sand and iron sulphides.

The mine makes 20 gallons of water per minute, and is kept unwatered by a Sterling pump, driven by a gasoline engine. There is a gasoline-engine-driven hoist, a No. 2 Breen blower, and a 120-cu. ft. Rix compressor. The washing plant consists of a 12-ft. trommel and 35 ft. of sluice lined with screen and Hungarian riffles. A total of 13 men were employed, four of whom were working underground.

Late reports state that all equipment has been electrified and that gold was being produced from the trough of the channel.

Calaveras Central Mine (formerly known as the *Victor, Rainier, Pierano)* is 1 mile north of Altaville. *The Calaveras Central Gold Mining Co., Ltd.,* 805 Hobart Bldg., San Francisco, has leased the present holdings, about 1,000 acres, from the *Calaveras Central Mining Corp.* The officers of the operating company are: Harry Sears, president; Desmond Sears, secretary; and C. P. Chamberlain, treasurer. W. H. Warwick is mine superintendent. The present owners acquired part of the property from the *Victor Land and Mineral Co.* about 1926, and the remainder from other holders in 1933.

This property is located along 3½ miles of the ancient auriferous Central Hill channel, below, and west of the Vallecito Western mine.

The channel comes into the property from the northeast, makes a bend, and courses northwestward. At this bend, the channel has apparently divided into two major streams, with a combined width of ¼ to ½ of a mile, separated by bedrock ridges or islands. Two other channels are encountered in the property which seems to be separate and additional to the main Central Hill flow. The ground seems to have been a wide valley or basin. A gradual elevation in bedrock has been encountered as work progresses down stream, indicating that the original grade of the stream was altered by an uplift of the country to the northwest. Results of recent geophysical surveys show that this is a probable cause of faulting to the east. This survey also indicates that a deeper channel follows partly along the line of the fault.

The present 350-ft. 3-compartment vertical shaft is approximately midway between the various channels. This shaft passed through three main gravel deposits interspersed with layers of volcanic ash or tuff. The width and depth of pay gravel varies in the various channel troughs. The pay gravel is from 60 to 70 ft. wide in one channel and from 150 to 200 ft. in another. An average of 3 ft. of bedrock and from 3 to 6 ft. of pay gravel are mined and milled. The gravel is said to run from $4 to $6 a ton. Considerable pyrite and some black sand are found with the gravel. The gold is largely coarse, and contains about 10% gross weight of silver. The gravel is partly cemented, and the rocks consist mainly of quartz and granite, worn to oval or flat shape. Large boulders are found. The bedrock is mainly Calaveras slate. Numerous quartz stringers are encountered in the bedrock, and it is planned to develop these at depth at some future time. Approximately 150,000 gallons of water are pumped out of the mine per 24 hours by use of a Sterling turbine pump, driven by 30-h.p. motor.

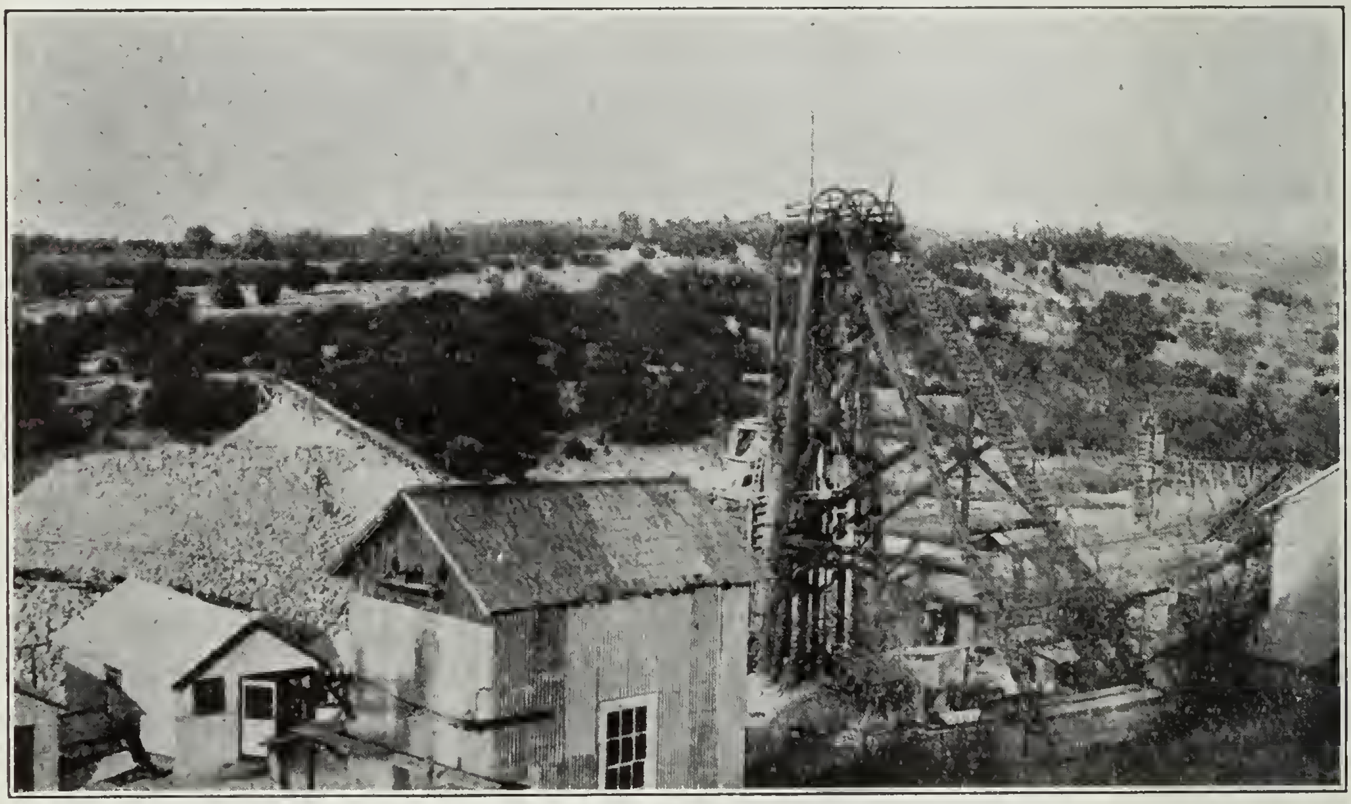

FIG. 15. Headframe at Calaveras Central Mine.

The property has been opened up about 1,600 ft. upstream, but recent operations are approximately 2,000 ft. from the working shaft down stream. The Pierano shaft, 240 ft. deep, located about 800 ft.

southeast of the working shaft is used for ventilation and as an emergency exit. A main crosscut to the north rim of the channels is now being developed.

Loading underground into 2-ton cars is done with the aid of four Eimco mucking machines and one Nordberg-Butler shovel. Loaded mine cars are hauled to the shaft by 3 storage-battery locomotives. The gravel and waste are hoisted in 2½-ton skips to a 50-ton surface ore-bin. Waste from a separate 30-ton bin is stacked by a 24-inch by 200-ft. conveyor belt.

The auriferous gravel from the gravel bin goes to a 21 ft. by 5 ft. trommel for washing and screening. The oversize material is stacked by a 24-inch by 275-ft. conveyor belt. The undersize gravel, (1 inch), is washed through a 24-inch sluice with a specially designed concentrating device, and over 24 ft. of Hungarian riffles, 12 inches wide. This material is dewatered by a drag classifier and conveyed to a Leahy vibrating screen (¼ and ⅛ inch mesh). The graded gravel passes down to a concentrator. The slime discharge from the concentrator is hoisted by a bucket elevator and conveyed by launder to the tailing dump. The coarse material from the Leahy screen is stacked by a 10-inch by 150-ft. conveyor belt. Production has varied from 75 to 200 tons daily.

The gravel and tailings have been handled and treated in various ways to determine the best method for extraction of maximum values. The management is now planning the early erection of a new and considerably larger milling plant with a capacity of 500 to 600 tons, a changed flow sheet, to conform to its final conclusions as to gravel treatment, a larger head frame, skips and underground gravel and waste storage and handling facilities.

Other present equipment includes a double-drum electric hoist, two 400 and 700-cu. ft. Sullivan angle compound compressors, saw mills, blacksmith and machine shops, large change rooms, first aid building, office, and other structures. Fifty-five men are employed three shifts a day.

Calaveras Holding Trustees, Ltd., Box 135, Camanche, controls approximately 200 acres of land in Sec. 8, T. 4 N., R. 10 E., 2½ miles east of Camanche. M. C. Gibford is president and manager, and E. B. Hill is secretary of the organization. The gravel deposit was worked by hydraulicking when operations first commenced in 1933. This did not pay because it was too expensive to pump so much water 2,000 ft. and elevate it 275 ft. from Mokelumne River. A 10-unit Huelsdonk concentrator was later installed, and it operated at intervals from June, 1935, to November, 1935. This machine proved not entirely satisfactory here, and another type of washing plant may be installed. The gravel is from 10 to 20 ft. in depth, lying on top of a clayey lava bedrock. It is said to test better than 25¢ per cu. yd.

The last operation consisted of mining the gravel by means of a P. and H. gasoline shovel, with a ¾-cu. yd. bucket. It was then hauled from 300 to 400 ft. by means of a 5-cu. yd. truck to a 10-cu. yd. bunker, whence it was conveyed by a 40-ft. rubber belt to the Huelsdonk concentrator, which handled 30 cu. yds. an hour. The tailings from the concentrator were then washed over a 25-ft. sluice lined with riffles. The coarse rocks were stacked by a conveyor belt. A Dean triplex pump, driven by a 40-h.p. motor, pumped the water from the river. Property was idle early in December, 1935.

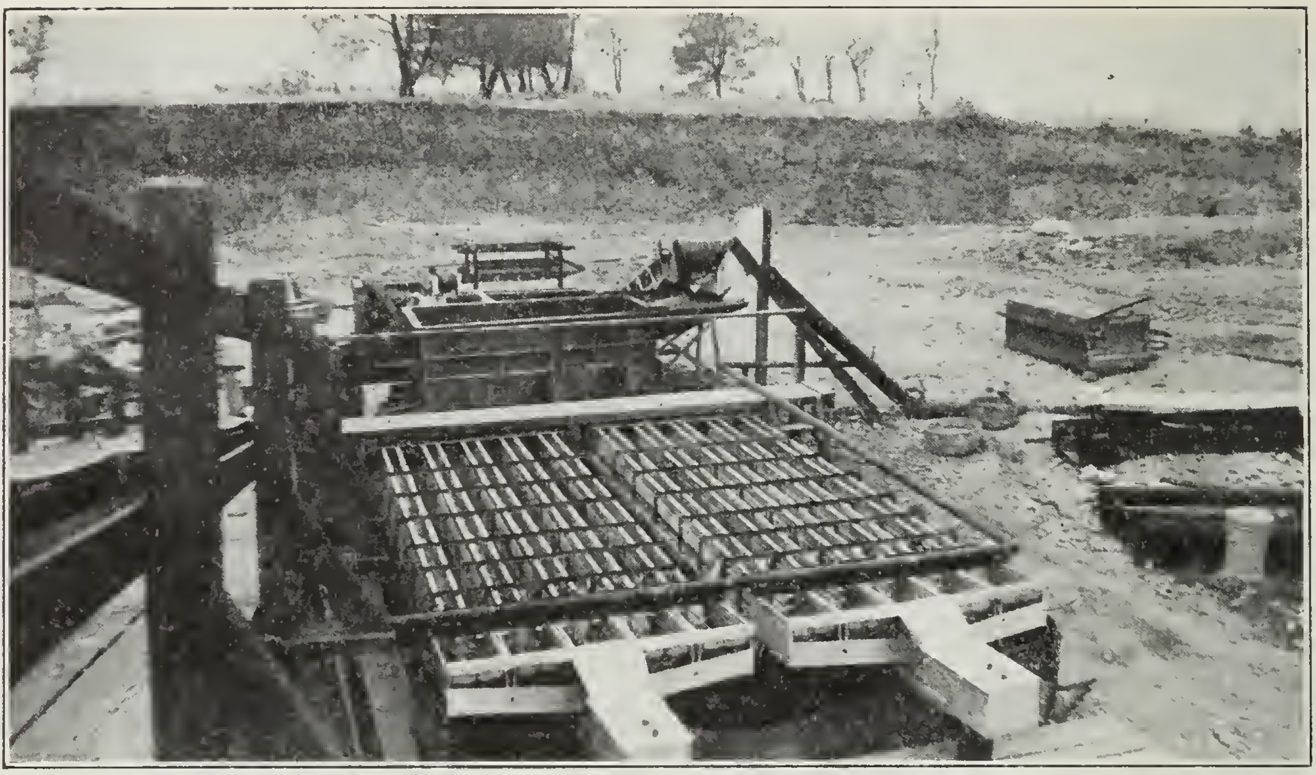

FIG. 16. Huelsdonk concentrator and gravel bank on property of Calaveras Holding Trustees, Ltd.

Calaveritas Hill Hydraulic Mine, formerly the *Baldwin property,* is operated by the *East Fork Mines, Inc.,* 1102 Easton Building, Oakland; mine address, San Andreas. F. I. Phelps and W. F. Woolley are actively engaged in the operations. This old hydraulic property is near Calaveritas, about 5 miles southeast of San Andreas. The 80-acre property includes the Calaveritas Hill Consolidated and Frenchy placer claims on the Central Hill Channel, and three tailing easements. The mine was ordered to close down by the California Debris Commission when last operated about 1914, because the operators would not rebuild a broken dam to store tailings. The company also controls 280 acres on the Fort Mountain channel in Secs. 19, 30, and 31, T. 4 N., R. 12 E., covered by the present ditch system.

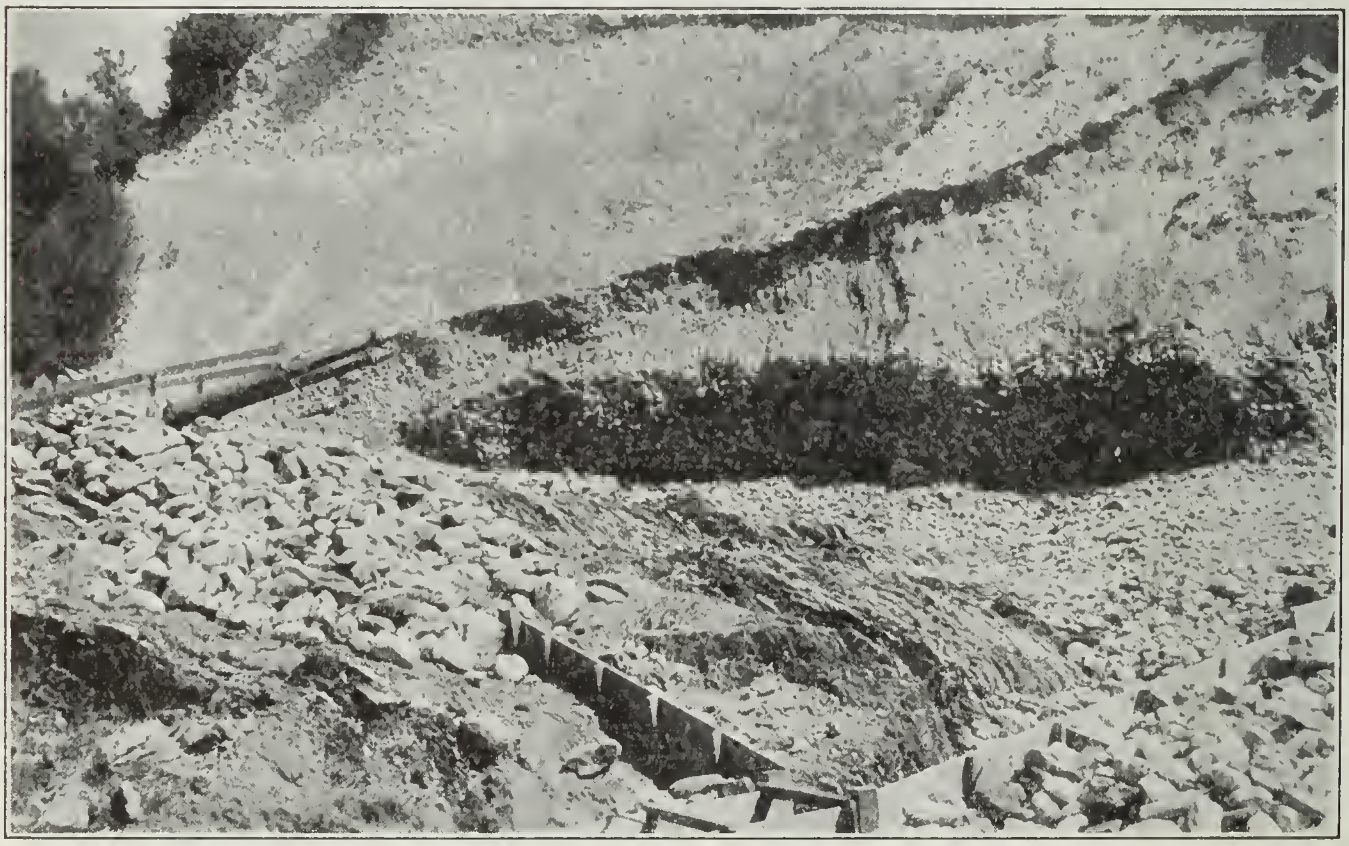

FIG. 17. Two No. 4 giants and gravel bank at Calaveritas Hill Hydraulic Mine.

The gravel bank averages 75 ft. in height, with a width of about 600 ft. and a length of 2,640 ft. It is estimated that there are 4,400,000 cubic yards of workable gravel, averaging 30¢ a yard. The gravel is tight but not cemented. The bedrock is a soft, laminated slate, the top of which is 225 ft. above nearby Calaveritas Creek. Twelve miles of ditch, taking water from O'Neill and McKinney creeks, end at a penstock, from which 6,000 ft. of pipe conveys the water to the giants which operate under a 212-ft. head. Two No. 4 giants are used. Sluice and tail-race boxes total 492 ft. in length. Permit to hydraulic was given by the California Debris Commission after an earth-fill restraining dam in a nearby dry gulch was built in December, 1935. Fifteen men are employed at the mine and to work on the ditches.

Hydraulic operations commenced the early part of 1936, but were brought to a close when heavy rains washed out the ditches and it was found necessary to replace a large portion of the pipe line. Hydraulicking was later resumed for a few hours each day, but the present water supply will be exhausted near the end of May, 1936, and hydraulicking will cease until about November, the next water season. The men will be employed in improving the ditch system, constructing a new reservoir for water storage, and installing new pipe during the summer. It is also proposed to explore and prospect the gravel deposits on the Fort Mountain channel.

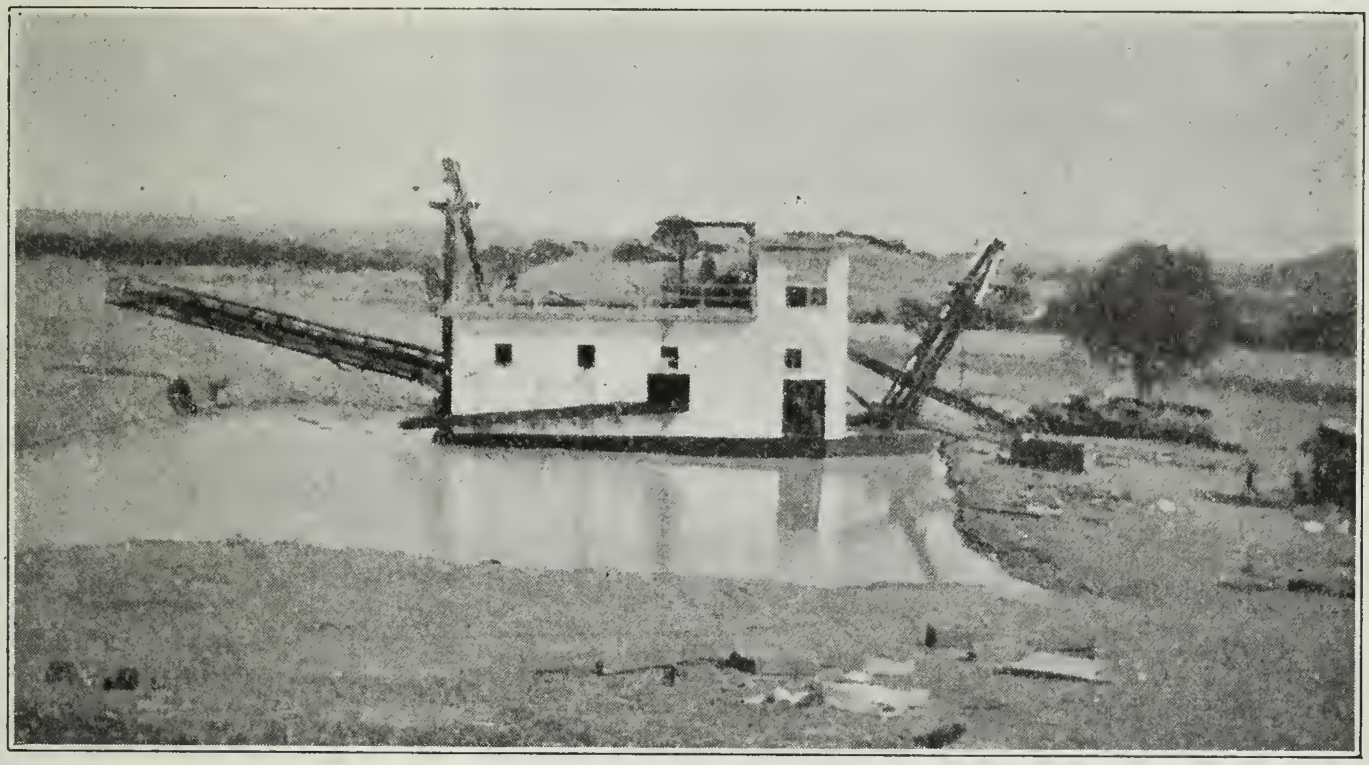

FIG. 18. Dredge operated by Camanche Placers, Ltd.

Photo by M. A. Newman

Camanche Placers, Ltd., has a small dredge operating in Sec. 12, T. 4 N., R. 9 E., on the edge of the village of Camanche, $\frac{1}{4}$ mile south of Mokelumne River. It is operated by a copartnership, of which R. E. Martin and L. B. Walbridge are active partners. M. A. Newman is general manager. Walter Johnson commenced building the dredge in July, 1935, and it began operating September, 18, 1935. Over 180 acres of land are controlled.

The auriferous gravel is from 8 to 10 ft. thick. The bedrock is a clayey tuff. The gold is fine, and tests about 850 fineness. Very little platinum is recovered. The dredger has 63 buckets of $2\frac{1}{2}$ cu. ft. capacity each, and is designed to dig 14 ft. below water level. The digging ladder is 60 ft. long. The steel hull is 60 ft. long, 32 ft. wide and 5½ ft. deep. The washing plant consists of a 20-ft. screen trommel, gold saving table, and sluices with Hungarian riffles and screens with cocoa matting. There is a 50-ft. belt conveyor for stacking. The dredge uses a total connected load of 123-h.p. The boat is supplied with a General Electric arc welder. A bulldozer is used to build levees to provide ponds. Water is pumped from the Mokelumne River by means of a 40-h.p. Byron Jackson high speed centrifugal pump. A total of 15 men are employed during the three shifts.

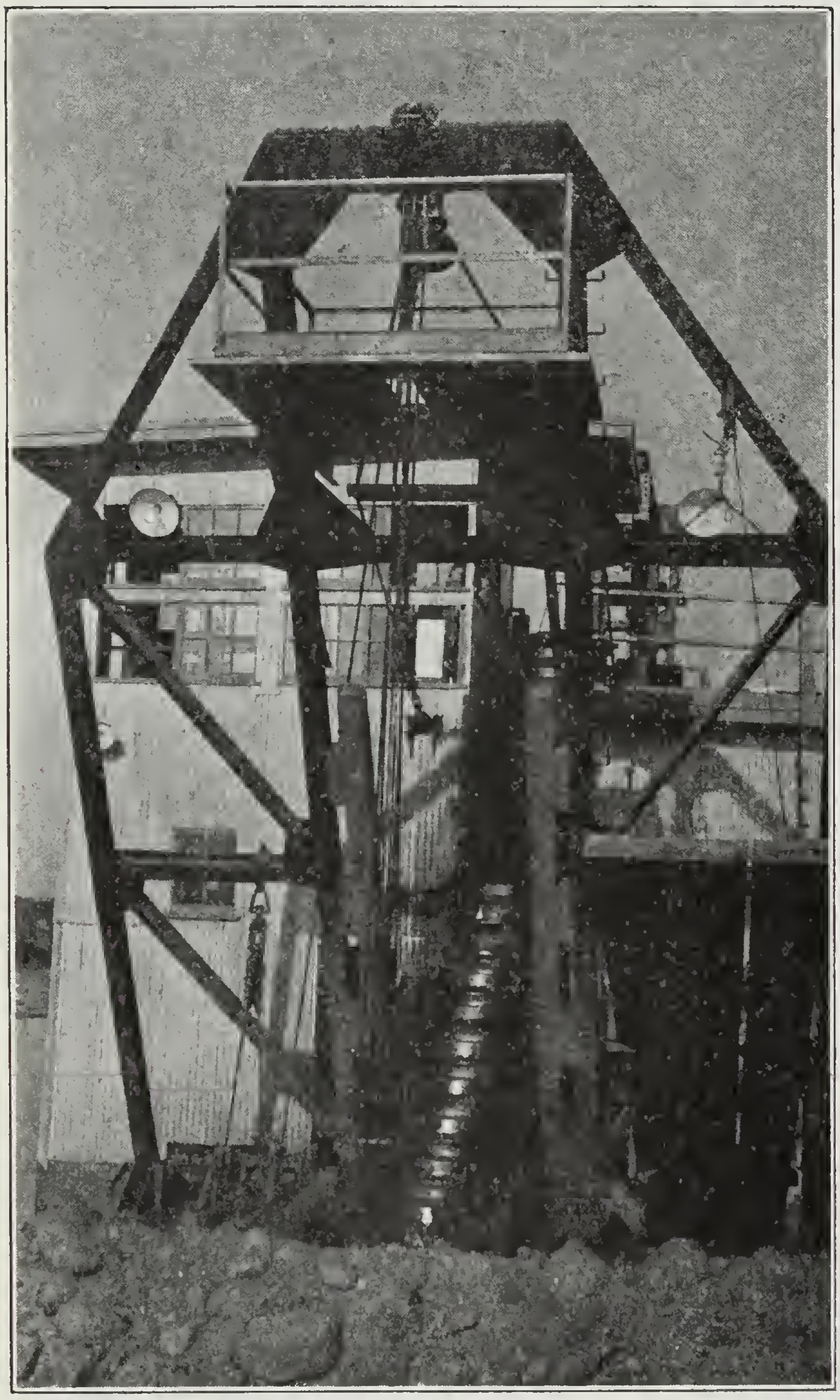

FIG. 18a. Bucket line on dredge of Camanche Placers, Ltd.

Photo by M. A. Newman.

Cassinelli, or Rising Star Placer Mine, adjoins the Lloyd mine to the north. It is 5 miles northwest of San Andreas, on the Deep Blue Lead Channel, as well as three other parallel channels called the Gleason, Mullen and San Andreas. P. M. Miles, San Andreas, is operating the mine under an agreement from Charles W. Neilsen, San Andreas, who has an option from the owner, Frank H. Robson, trustee for *Ancient River Corporation.* The mine was re-opened about 1932, but the present operator did not commence working until December, 1934.

A 2000-ft. adit driven southwestward, crosscuts the San Andreas, Mullen, Gleason and Deep Blue Lead channels, in the order named. Only the latter channel is now being worked, although the Mullen Channel was extensively worked many years ago to the south of the present tunnel. It is said to have been rich. The Gleason Channel is also said to have produced a considerable amount of gold in the early days. Its development was mainly to the north of the tunnel, although some work was done downstream, to the south. The San Andreas Channel has never been prospected at this point.

The Deep Blue Lead Channel was worked upstream, northward, in the early days. The Ancient River Corporation last worked the chan-

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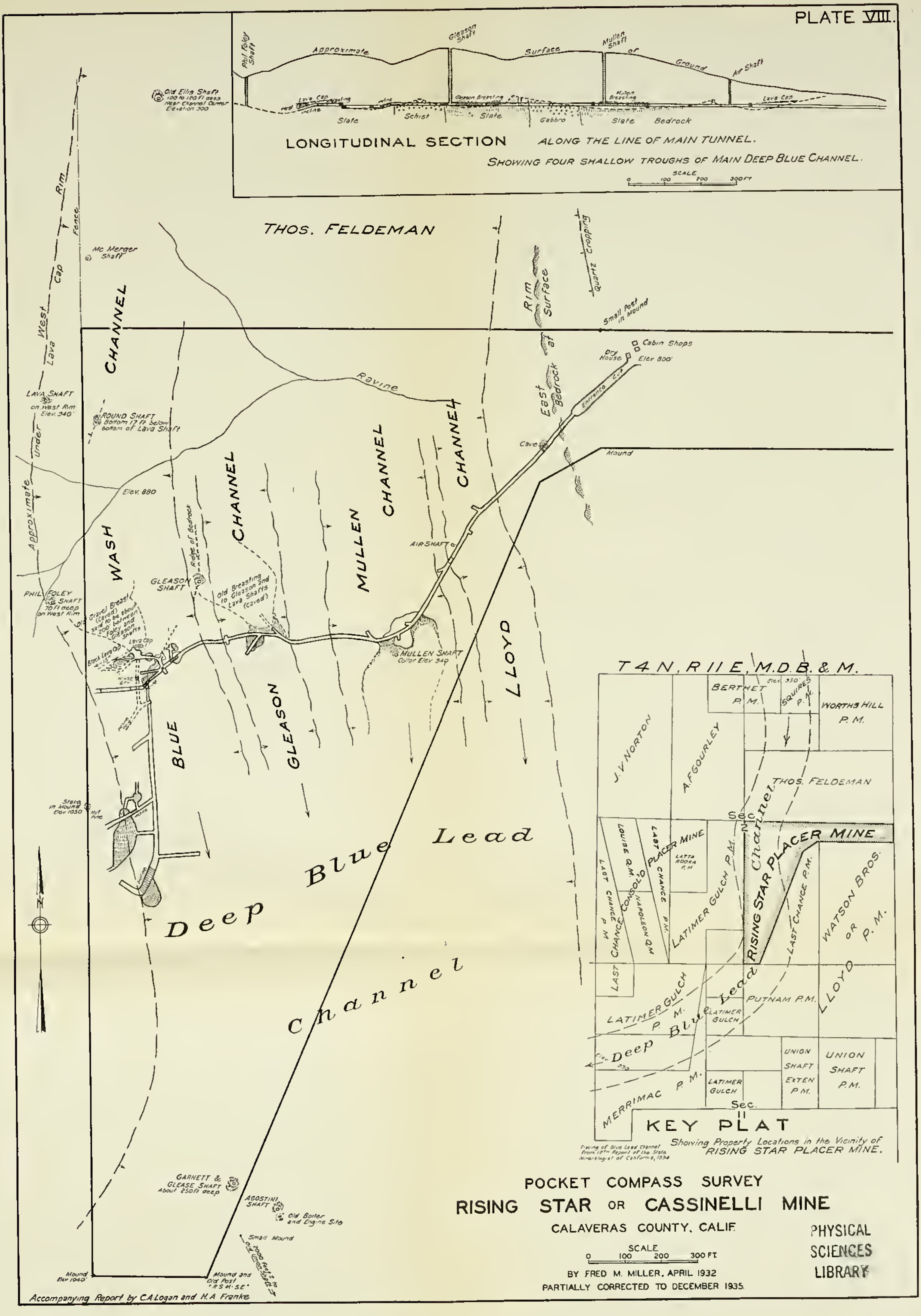
PLATE VIII.


Phil Foley Shaft
Gleason Shaft
Mullen Shaft
Air Shaft
Approximate Surface of Ground
Lava Cap
Gleason Breasting
Mullen Breasting
Incline
Slate
Schist
Slate
Gabbro
Slate
Bedrock
LONGITUDINAL SECTION ALONG THE LINE OF MAIN TUNNEL.
SHOWING FOUR SHALLOW TROUGHS OF MAIN DEEP BLUE CHANNEL.
SCALE
0 100 200 300 FT
Old Ellis Shaft 100 to 120 ft deep Near Channel Center Elevation 900
THOS. FELDEMAN
Approximate Under Lava West Cap Rim Fence
Mc Merger Shaft
Quartz Cropping
Rim Surface at East Bedrock
Small Post in Mound
Cabin Shops
Dry House
Elev 800'
Entrance Cut
Cave
Mound
Ravine
LAVA SHAFT on West Rim Elev. 940'
ROUND SHAFT Bottom 17 ft below bottom of Lava Shaft
Elev. 880
Ridge of Bedrock
GLEASON SHAFT
Old Breasting to Gleason and Lava Shafts (caved)
PHIL FOLEY SHAFT 70 ft deep on West Rim
Old Gravel Breast (caved) said to be about 200' between Foley and Gleason Shafts
Lava Cap
Black Lava Cap
AIR SHAFT
MULLEN SHAFT Collar Elev 940
WASH CHANNEL
BLUE CHANNEL
GLEASON CHANNEL
MULLEN CHANNEL
LLOYD CHANNEL
Slate in Mound Elev 1050
Deep Blue Lead Channel
GARNETT & GLEASE SHAFT About 250 ft deep
AGOSTINI SHAFT
Old Boiler and Engine Site
Small Mound
2000 feet ± to Old Union Shaft
Mound Elev 1040'
Mound and Old Post "R S M · S E"
Accompanying Report by C.A. Logan and H.A. Franke
T4N, R11E, M.D.B.&M.
BERTHET P.M.
Elev. 950'
SQUIRES P.M.
WORTHS HILL P.M.
J.V. NORTON
A.F. GOURLEY
THOS. FELDEMAN
Sec. 2
Channel
RISING STAR PLACER MINE
LAST CHANCE P.M.
LOUISE Q.M.
CONSOL'D PLACER MINE
LAST CHANCE P.M.
NAPOLEON Q.M.
LATTA ROOKA P.M.
LATIMER GULCH P.M.
LAST CHANCE P.M.
WATSON BROS. OR P.M.
LAST
LATIMER GULCH P.M.
LATIMER GULCH
PUTNAM P.M.
LLOYD
Deep Blue Lead
Elev. 930
UNION SHAFT EXTEN P.M.
UNION SHAFT P.M.
MERRIMAC P.M.
LATIMER GULCH
Sec. 11
KEY PLAT
Showing Property Locations in the Vicinity of RISING STAR PLACER MINE.
Tracing of Blue Lead Channel from 12th Report of the State Mineralogist of California, 1894
N

POCKET COMPASS SURVEY
RISING STAR OR CASSINELLI MINE
CALAVERAS COUNTY, CALIF.

SCALE
0 100 200 300 FT.

BY FRED M. MILLER, APRIL 1932
PARTIALLY CORRECTED TO DECEMBER 1935.

PHYSICAL
SCIENCES
LIBRARY

nel from about 1920 to 1925. The present operators have drifted 1400 ft. southward, or downstream, from which drifts and breasts have been developed westward. The pay gravel is about 100 ft. in width. The gravel is 20 ft. in depth, of which about 3 ft. is pay dirt. It is very compact and occasionally cemented. The gold is of medium size, with an occasional nugget. A considerable amount of black sand and pyrite accompanies the gold. There are many boulders. The bedrock consists of hard and decomposed slate. The channel is capped by a breccia of andesitic and rhyolitic pebbles, which is overlain by surface gravels. The mine makes about 25,000 gallons of water a day.

The gravel is hauled from the mine in eight 16-cu. ft. capacity cars by means of a storage battery locomotive. It is dumped into a 60-car gravel bin, which is about 700 ft. from the portal of the adit. The washing plant consists of a 3 by 12-ft. trommel, and a 60-ft. sluice lined with wooden riffles. The coarse material from end of trommel is stacked by belt conveyor in a bin, whence it is hauled away by truck. Thirty-five cars of gravel have been treated daily. Other equipment includes 4 Worthington air blowers, a 10 by 12-inch Ingersoll-Rand compressor, and a centrifugal pump, all driven by gasoline engines. A total of 12 men are employed one shift, including 8 underground.

Central Hill Mine, formerly known as *Barker Claim, Union Shaft Mine,* is 4 miles by road northwest of San Andreas. The *Central Hill Mining Company*, 1020 Fairoaks, South Pasadena, leased the property from Chas. F. Claudon, 1125 Watkins Drive, Pasadena, owner, and commenced operations in March, 1934. Chas. F. Claudon is president, and William W. Reesink is secretary and superintendent of the company.

It is on the Central Hill channel, sometimes called San Andreas channel, which courses almost north. The vertical depth to the gravel is 136 ft. The gravel is cemented, and contains a few boulders. The gravel is from 50 to 75 ft. in width and 20 ft. deep in the bottom of the channel's trough. Development includes a 370-ft. shaft driven on a 32° and 31° incline N. 70° E. The shaft passed through gravel, a buff-colored lava ash, then more gravel, to slate bedrock. The general trend of drifting operations is northward, downstream, but up-grade, because the channel has been tilted up on the north end. The most northward drifts, toward the old Union shaft, are being driven through slate bedrock. The present operators have completed about 800 ft. of drifting and have done some breasting. They have also cleaned out some of the old former workings.

Most of the gold is found in the first 3 ft. of bedrock and the 3 ft. of gravel above bedrock, which is mined and treated in the washing plant. Twenty-five cars, each of 20-cu. ft. capacity, are mined and treated daily, when the operations are in pay dirt. The gold is found from pin-head to wheat-grain in size, with occasional $3 to $8 nuggets. It ranges from 818 to 825 in fineness. The washing plant consists of an 8-ft. by 30-inch trommel, and 48 ft. of sluice with wooden riffles. Other equipment includes a single-drum hoist, Garret jackhead pump, and a 220-cu. ft. air compressor. All equipment is driven by gasoline engines. A total of 7 men are employed for one shift, which includes 4 men underground.

Chili Gulch Dredge is operating under a partnership formed by C. W. Neilsen, Stephen Kaminski and F. C. Fritz of San Andreas. The dredging ground consists of one mile of sand and gravel along the bed of Chili Gulch, about 2½ miles northwest of San Andreas, which is owned by Charles Snyder, San Andreas. The gravel is from 12 to 30 ft. in depth, and is said to test 28 cents a cu. yd. There are very few boulders. The 'bedrock' is a blue gouge.

Construction of this dredge commenced in September, 1935, and it started operating the latter part of January, 1936. The wooden hull is 30 ft. in length by 20 ft. in width, with a depth of 3½ ft. The dredge has 37 buckets of 1½ cu. ft. capacity each, which dump the gravel into a 44-inch by 12-ft. trommel. The fine material is washed over 60 ft. of sluice lined with riffles. Cobbles from end of trommel are stacked by a 22-ft. conveyor belt. All of the machinery is geared low enough for a 40-h.p. Buick gasoline engine to operate it. The dredge is said to be capable of treating 2,000 cu. yds. of gravel daily. Six men are employed, two on each shift.

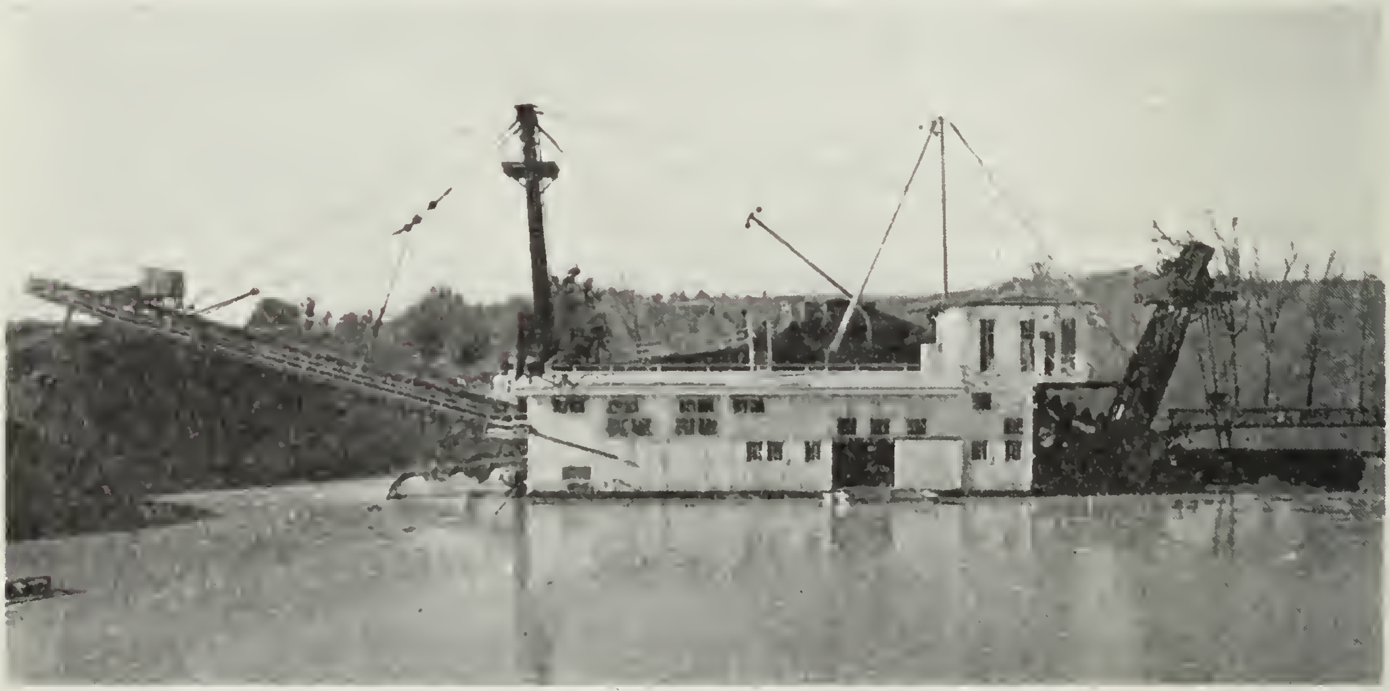


FIG. 19. Gold dredge of Comanche Gold Dredging Co., at Camanche.
Photo by courtesy of Pacific Gas and Electric Co.

Comanche Gold Dredging Company, 311 California Street, San Francisco, controls approximately 351 acres of dredging ground in Sec. 1, T. 4 N., R. 9 E., 1 mile north of Camanche, alongside the Mokelumne River, in Calaveras and Amador counties. Officers of the company are: E. B. De Golier, president; J. J. Coney and Stanley Hiller, vice presidents; L. R. Kerdell, secretary-treasurer; Harry G. Peake, manager; C. C. Cline, superintendent of operations.

It is estimated that it will take 6 years to dredge the present ground. The auriferous gravel is from 10 to 30 ft. in depth, averaging about 25¢ a cubic yard. Bedrock is a blue clay. Work on the dredge commenced in June, 1935, and dredging operations started in September, 1935. The steel hull consists of 28 pontoons, and is 105 ft. long, 50 ft. wide, and 7½ ft. in depth. The dredge has 63 buckets of 7½ cu. ft. capacity each, and is designed to dig 34½ ft. below the water level. The trommel is 30 ft. long and 6 ft. in diameter. The gold-saving table and sluices cover approximately 1800 sq. ft. About 4800 cu. yds. of gravel is treated daily. The total connected power-load is about 400 h.p. A total of 20 men are employed, including 5 men to each of the three shifts on the dredge.

Emery Property, as well as the *Juri, Domenghini, Hamilton,* and *Cuslidge* properties, 2 miles southeast of Mountain Ranch, are being prospected by the *Bradley Mining Company,* 920 Crocker Building, San Francisco. An option on the property was obtained from the *Gold Mining and Water Co.,* 208 Sharon Bldg., San Francisco. Worthen Bradley is president of the operating company. Phil Cox is in charge of the present work of testing the channel gravel by means of a Keystone drill outfit, which is operated on a 2-shift basis. The holdings consist of 2½ miles along the El Dorado channel, which here courses east and south. They embrace the following former workings, from the west to eastern end of the channel: *Rose Hill* hydraulic pit, *Humboldt* hydraulic pit, *Motto* hydraulic pit, and the *Gaston Hill* pit which was sluiced. The gravel is tight and contains some large boulders. It is not yet known how much gravel will be available, but it is roughly estimated at five million cubic yards. The gravel will probably average about 100 yds. in width and be from 10 to 20 ft. in depth. The property will be worked by means of a power shovel and washing plant, commencing on the east end of the channel, provided the present tests check out satisfactorily.

Twelve miles of old ditch from Jesus Maria Creek to the Emery reservoir (1,000-acre feet of water) and 5 miles of ditch and pipe line to the channel workings will be rehabilitated to furnish a water supply. Ten men are now employed.

Davis, C. P., Ranch, in Sec. 3, T. 5 N., R. 13 E., 2 miles south of Railroad Flat, is being prospected by a crew of three men. Frank Schilling, 27 W. Oak Street, Stockton, has leased 20 acres from C. P. Davis, R. F. D. No. 1, Box 39, Mokelumne Hill. A 70-ft. vertical, single-compartment shaft has been sunk 70 ft. through 60 ft. of rhyolite lava, while the bottom 10 ft. is in loose slate rock and some blue gravel. The operators state they are on a side or bench channel off of the main Blue Channel. Equipment includes hand tools and a gasoline-engine-driven hoist.

The old *Lamson* drift mine is about ½ mile east of the above prospect. A 100-ft. shaft is said to have been sunk to bedrock, and drifts run 150 ft. east, 100 ft. west and 24 ft. north, but an insufficient amount of pay gravel caused operations to cease. This property was last worked from June to October, 1935.

There is an old 80-ft. shaft between the two above mentioned properties that is said to have been last worked in 1928.

Deep River, or Rosenthal Mine, is 5 miles northeast of Mountain Ranch. Frank Rosenthal, Mountain Ranch, located and commenced working this claim in July, 1934. It is said to be on the Fort Mountain Channel, which courses southeastward. An 80-ft. vertical shaft has been sunk through gravel to bedrock. A lava capping covers the channel to the east. A 300-ft. drift is being driven eastward, after failing to find pay gravel in a 300-ft. drift to the west. The east drift is now said to be showing pay gravel. The gravel is loose. Equipment includes hoist, Ingersoll-Rand compressor, two blowers, and a water pump, all driven by gasoline engines. There is a concrete mixer and short sluice to test the gravel. The mine makes about 20 gallons of water per minute. Three men are employed.

Duck Bar Placer Claims, comprising 120 acres of sand and gravel bar on the Stanislaus River, is situated 6 miles northeast of Vallecito. The higher gravels were worked many years ago. A. B. Knapp of Vallecito plans to work the lower gravel beds with the aid of a suction dredge in the near future. Most of the gold is found in the pot holes in the limestone bedrock. M. H. Manuel, Murphys, owner.

E. and B. Mining Company took over the property of the *Calaveras Rock Company, Inc.,* Valley Springs, in the spring of 1936. The former company had leased 110 acres of land formerly known as the *South Hill Mine,* from J. W. Phillips, Valley Springs, in 1934. The property is in Sec. 3 or 4, T. 4 N., R. 10 E., 1 mile west of Campo Seco and 1¼ miles southeast of Mokelumne River. Officers of the former Calaveras Rock Company were: Charles Pearson, president; H. V. Burgard, vice president and manager; O. V. Barkman, secretary. The principals of the new company are E. and B. Royce and C. I. Wild.

The deposit consists of from 3 to 10 ft. of exposed cemented gravel lying on top of about 20 ft. of altered schist, said to be a false bedrock and underlain with more gravel. Four million tons of cemented gravel, averaging $3 a ton, are estimated to be available near the present mill, which was built in April, 1934. A total of 12 million tons is said to be available from adjoining deposits. The present pilot mill was operated at intervals from July 3, 1934, to November 26, 1935, but it was considered not entirely satisfactory. The cemented material was crushed to 1½-inch size by a 12 by 20-inch Aurora jaw crusher, then elevated 32 ft. to a 100-ton ore bin, from where it was fed to a 50-ton Gibson rod-mill, grinding to 20-mesh. The pulp was then treated by two Codding submerged amalgamators and four Gibson concentrating tables. The new company proposes to replace the old mill with a washing plant, followed by a 300-ton No. 76 Traylor mill, four No. 6 Wilfley concentrating tables and a Denver flotation unit. They plan to mine the cemented gravel by means of a steam shovel.

Water for the plant is pumped from Mokelumne River by means of a Worthington horizontal triplex pump, driven by a 30-h.p. motor. The pipe line is 8,800 ft. long and the water must be elevated 372 feet. Electric power is supplied by the Pacific Gas & Electric Company. Four men are employed.

Eclipse, or *Infernal Placer Mine,* 2 miles south of Mokelumne Hill, is on the Tunnel Ridge Channel. O. B. Brown and J. J. Fillerup, Mokelumne Hill, present operators, obtained their lease from R. H. Cross, Mills Bldg., San Francisco, who acts as agent for the New York owners. Present work started May, 1934.

The channel courses southwestward. It is overlain with a cemented conglomerate and a basalt lava-flow. The present operators are prospecting for the unworked portion of the channel, but have obtained some production from remaining loose gravel pockets in the old workings which have been crosscut. The gold is found to be coarse, and mainly on bedrock. Present workings includes a 250-ft. adit driven westward, from which point it was driven 150 ft. northwestward, followed by a 125-ft drift north and 25 ft. south. The bedrock consists of a soft decomposed slate. Many boulders are encountered.

The gravel is trammed to a 75-cu. yd. gravel bin, from which it is fed to a 24-ft. trommel. The screened material is washed down a 40-ft. sluice lined with Hungarian riffles. The inadequate supply of water from the mine makes it necessary to pump water 400 ft. up the hillside from Old Woman's Gulch. Hand tools are used in the mine. Three men are employed one shift.

El Capitan Placer Mine, adjoining the Bon Ton mine on the west, about 5 miles north of Murphys, is owned by George S. Taylor, Murphys. There are three shafts, 50, 100 and 200 ft. deep on the property. Idle.

El Encino, or *Chappellet Mine,* adjoining the old Pellaton mine, 2½ miles south of Mokelumne Hill in Chili Gulch, is to be operated by J. C. Radler, 6457 Oakwood Drive, Oakland, and associates, commencing in May, 1936. Plans are to work off the tailings which accumulated in the gulch from early day operations by means of a 6-cu. yd. Fresno scraper, drawn by a caterpillar tractor. This deposit consists of loose, medium-sized white-quartz gravel. A washing plant, consisting of trommel and sluice, is to be erected. Later, it is planned to work the Deep Blue Lead Channel on the same property. George S. White, 3004 Grove Street, Berkeley, owns the property.

Flume House Prospect, in Sec. 23, T. 5 N., R. 11 E., 2½ miles southwest of Mokelumne Hill, is thought to be on the Concentrator or Corral Flat channel. N. O. Hendricks, Valley Springs, and associates leased this 160-acre holding from the *Union Mining Company,* who closed their unsuccessful operation at another location on this property in 1931. Address of the Union Mining Company is: c/o Mr. Holmes, Santa Fe Railroad, San Bernardino. Hendrick's work started in October, 1934.

The present operators have sunk a 332-ft. vertical shaft, which passed through 60 ft. of wash rock, 50 ft. of hard-rock flow, 40 ft. of white lava, 150 ft. of brown clayey lava interspersed with gravel, to the slate and soapstone bedrock. An 80-ft. crosscut was then driven northeast through slate and gravel. Fifty feet in on this crosscut a 60-ft. drift was driven southeast and a 120-ft. drift driven northwest. A 20-ft. crosscut northeast had been driven from the end of the 120-ft. drift in the early part of December, 1935. The channel is thought to course southeastward.

The washing plant consists of a 5 by 15-ft. trommel, with a 50-ft. sluice, 20 ft. of which is lined with Hungarian riffles. Other equipment includes a Rix air compressor, jack-lift pump, and hoist, all driven by gasoline engines. A total of nine men are employed two shifts, including four who are prospecting underground.

Fort Mountain Mine (formerly *Mohawk, Solari, Rigney, Baldwin*) is situated 4½ miles northeast of Mountain Ranch, on the Fort Mountain channel. It is owned by the *Fort Mountain Mining Company,* of which Dr. A. Galbraith, Wakefield Building, Oakland, is president. The company last operated this property from December, 1934, to January, 1935. Workings include a 300-ft tunnel driven north into the channel, from which point some drifting has been done northeastward. The cemented pay-gravel is said to be 100 ft. in width, and about 6 ft. in depth. There is considerable coarse gold, running 888 in fineness, said to average $4.50 per cu. yd. Equipment includes a Price gravel mill, concentrating table, sluice with undercurrents, and a 240-cu. ft. Ingersoll-Rand compressor, driven by a 100-h.p. diesel engine. Plans are to resume drifting operations at an early date. It is also planned to resume work on the old Baldwin hydraulic mine, situated on the same property. An 8-mile ditch from O'Neil's Creek will furnish water for hydraulicking.

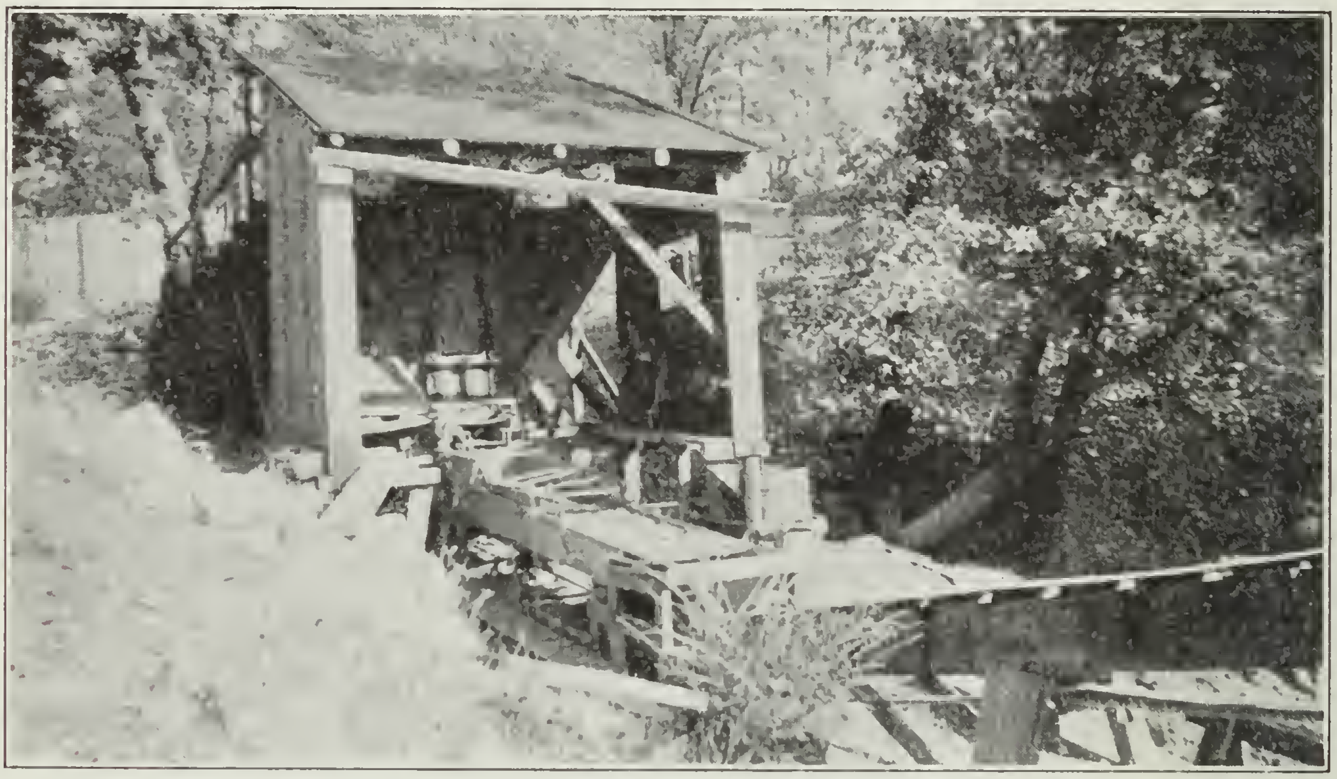


FIG. 20. Thompson placer machine at Gold Chief Placer Mine.

Fourth of July Claim, ¾ mile north of Campo Seco, is leased to Willard Woodworth, Valley Springs. F. E. Pickard, Campo Seco, is owner. This gravel deposit is overlain with lava interbedded with gravel. The partly cemented gravel is about 4 ft. in depth. Values average about $1.15 a cu. yd. The 1½ ft. of gravel on surface is said to average 65¢ a cu. yd. A 65-ft. vertical shaft has been sunk to the false, altered-andesite bedrock. Drifts, totaling about 250 ft., have been driven in all directions from the bottom of the shaft, connecting with three other shallow shafts. A Chandler gasoline-engine-driven hoist lifts the pay dirt to a 10-cu. yd. bin. Due to the lack of water, it is necessary to haul the auriferous gravel by truck to the banks of Mokelumne River. A small trommel and a 60-ft. sluice with riffles are used to recover the values. Hand tools are used in the mine. Two men are employed.

Gold Chief Placer Mine No. 1 and 2, formerly owned by the *Forest Creek Mining Company, Ltd.,* is now owned by Albert P. Myers, Los Angeles. Frederick Herbst has a bond and lease on the property, comprising 20 acres. It is located 4½ miles by road southeast of West Point, on the Licking Fork of Mokelumne River. This unpatented property has been worked intermittently since April 10, 1931, when it was first located by J. Porteous and Clyde Watson. It was last operated in September, 1935.

It is on the Fort Mountain channel, which courses southward at this point. The gravel, averaging 20 ft. in depth, is loose and contains some boulders. Bedrock is a decomposed slate. The gravel is said to average $1.30 a ton. It was worked by a partly inclined tunnel, which runs northwestward for a distance of 525 ft. About 400 ft. of crosscuts and drifts have been driven from this tunnel, and are accessible. The last working face was 10 ft. high and 12 ft. wide. The mine makes very little water, making it necessary to pump water from the Licking Fork to the washing plant, a distance of 700 ft. and a vertical lift of 380 ft. Equipment includes a Byron-Jackson pump, Thompson placer machine driven by a gasoline engine, and a steam hoist to haul cars up the inclined tunnel.

Gold Gravel Products, Inc., Standard Oil Building, San Francisco, controls a gravel deposit in Sec. 13, T. 4 N., R. 9 E., 1 mile south of Camanche, leased from M. I. Crocker Estate, San Francisco. Officers of the company are: Warner Clark, president; W. V. Clark, vice president; J. W. Gruver, office manager; W. R. Clark, secretary-treasurer and general manager of operations. The company owns and leases approximately one section of land in this vicinity, and it has been estimated that about 2 million cu. yds. are available near the Camanche site. This shore-line deposit of auriferous gravel is about 8 ft. in depth, and lies upon a relatively soft andesite bedrock. The gravel is tightly packed, mixed with sand and clay. There is an absence of any large boulders.

W. R. Clark was operating a dragline dredge when the property was visited in December, 1935. However, this operation was unsuccessful, lasting only five weeks, and the property near Camanche is now being worked by a stationary washing plant, much in the same manner as the previous operation near Wallace.

Construction of the dragline dredge began on October 15, 1935, and operations started in December, 1935. The wooden hull of the dredge was 40 ft. long, 30 ft. wide, with a depth of 3 ft. The 26-ft. Bodinson trommel included 8 ft. of scrubbing, 14 ft. of screening and 4 ft. of blank section, and was driven by a 30-h.p. Fairbanks-Morse motor, using a Falk gear-reducer attachment. The coarse material from end of trommel was stacked by means of a 50-ft. conveyor belt, which was driven by a $7\frac{1}{2}$-h.p. Fairbanks-Morse motor. Sluices lined with riffles caught the gold on both sides of trommel. A K-38

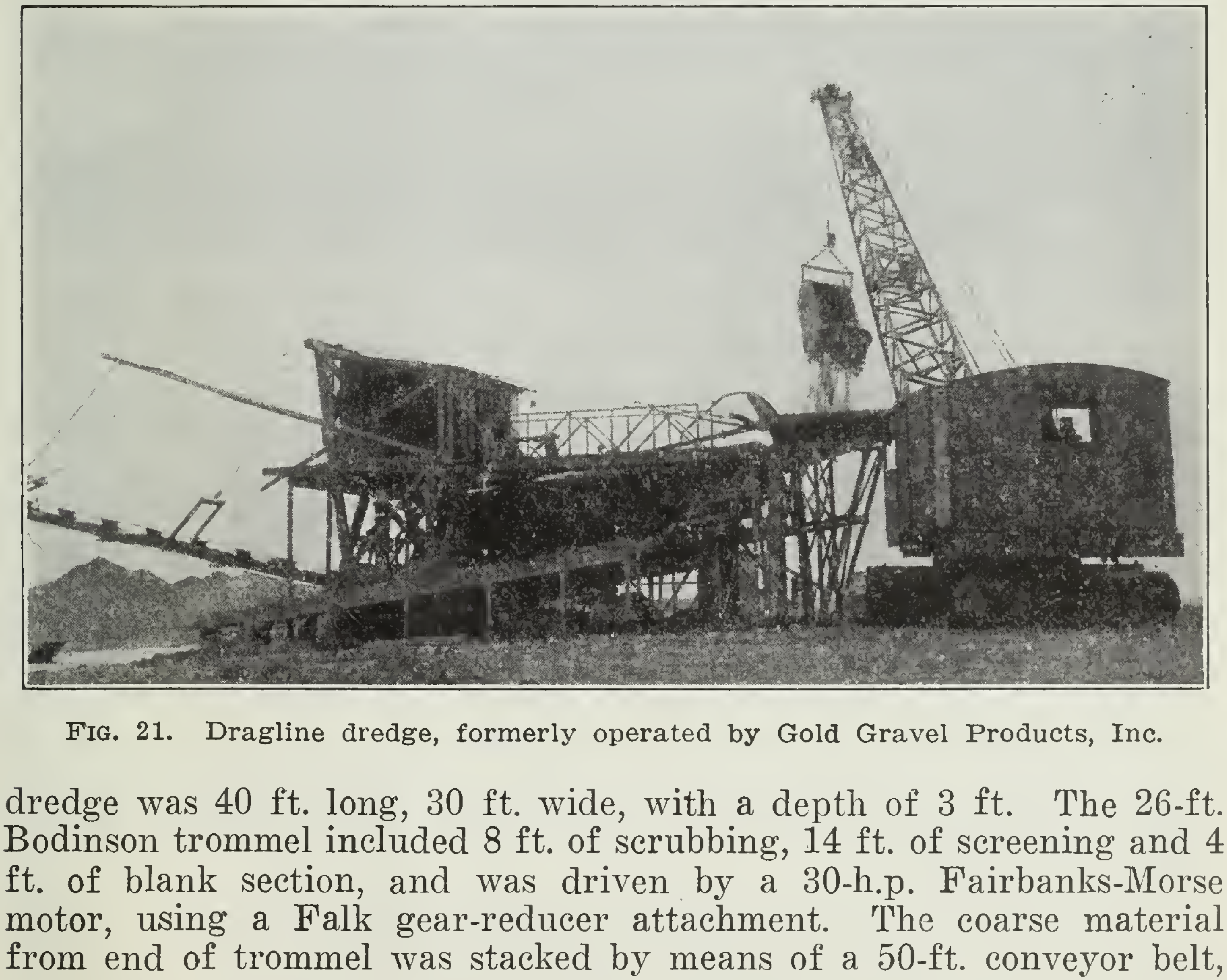


FIG. 21. Dragline dredge, formerly operated by Gold Gravel Products, Inc.

Link-Belt 100-h.p. gasoline shovel, with 50-ft. boom and 1¼-cu. yd. bucket was used to dig the gravel and load it into the hopper of the washing plant. The dredge capacity was said to have been 3000 cu. yds. in 24 hours. Three men were employed each of the three shifts. An electric welder was also employed. Water for operations was pumped a distance of 6000 ft. and elevated 255 ft. from Mokelumne River by means of a 40-h.p. Byron-Jackson high-speed pump and a Fairbanks-Morse booster pump. This operation is said to have failed because the ground was too hard to dig with the dragline shovel.

Resumption in operation of a stationary washing plant began early in 1936. The same gasoline shovel is used to mine the gravel, but it is now able to lift under and tear up the compacted gravel and load it onto cars which are hauled 1000 ft. to the washing plant by means of two 8-ton Plymouth locomotives. Four 6-cu. yd. and two 4-cu. yd. cars make a train. The gravel is dumped from the cars into a bin, whence it is fed to a 30-ft. trommel, consisting of 4 ft. of blank section, 8 ft. of scrubbing section with internal spiral and lifting vanes, 14 ft. of screening section with ⅜-inch holes; and again 4 ft. of blank section. The screened material is washed down a sluice lined with Hungarian riffles, 300 ft. long and 30 inches wide. The coarse material is conveyed by a 50-ft. rubber belt to a rock bin, from which it is hauled away by two 6-cu. yd. cars pushed by a 5-ton Plymouth locomotive. A total of 21 men are employed three shifts a day. A total of 7,000 cubic yards of gravel is treated weekly.

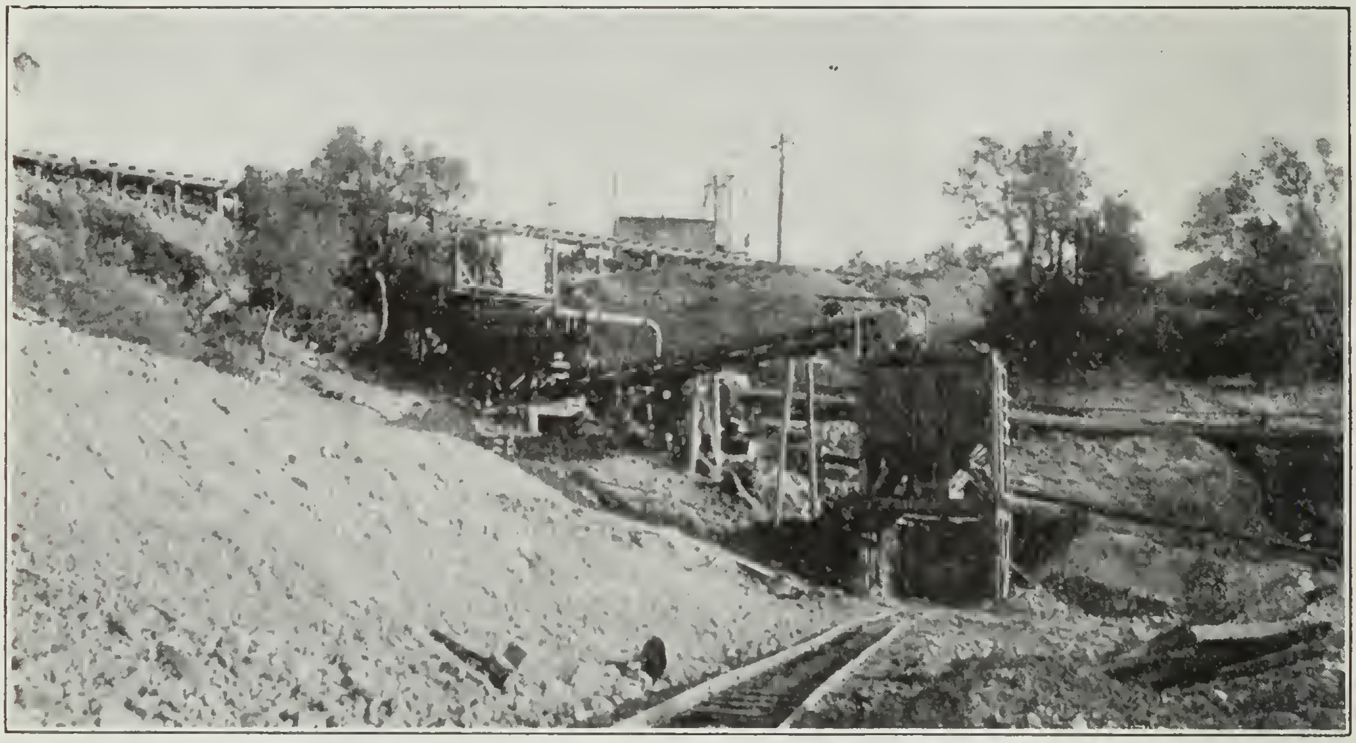


FIG. 22. Stationary washing plant, with track above, from which cars dump gravel into bin, Gold Gravel Products, Inc.

Part of this company's gravel holdings are in Sec. 15, T. 4 N., R. 9 E., near Wallace, which were previously worked for 1½ years. This operation was similar to the present one, using a gasoline shovel, with cars and locomotives to haul the material to a stationary washing plant near Wallace.

Gold Ribbon Mine, or *Archie Campbell Place,* in Sec. 36, T. 5 N., R. 11 E., 4½ miles north of San Andreas, on Chili Gulch, is said to have been hydraulicked in the 1880's by the *Mokelumne Ditch and Water Company.* This 200-acre property, of which only a portion is gravel bearing, owned by Charles P. Snyder, San Andreas, is leased to C. C. Cook, No. 18 Overlake Court, Oakland.

This exposed ancient-channel deposit, about 35 ft. in height, was prospected during the past winter by means of hydraulicking. However, the cemented gravel would not wash and it is now planned to mine it by means of a dragline. The best values are said to lie within the top 6 ft. of gravel and not on the slate bedrock. It is said to test 50 cents to $1 per cubic yard. Equipment on the property consists of a 100-ft. sluice lined with wooden riffles, 1500 ft. of 8-inch pipe with a 2-inch nozzle, and a 5-inch centrifugal pump driven by a 75-h.p. Holt motor which burns diesel oil.

An undeveloped quartz ledge, 30 ft. in width, striking northwest, is also said to traverse a part of the same property. The country rock is slate and amphibolite schist. The only working consists of a 50-ft. inclined (60° east) shaft.

Golden Queen Prospect, thought to be situated on the Central Hill Channel, $1\frac{1}{2}$ miles northeast of Angels Camp, in Sec. 11, T. 2 N., R. 13 E., is owned by J. Canepa, Angels Camp. Over 300 acres of the property are leased to Luke Cepanich and George Schmauder of Altaville. Development work began in April, 1935. A 116-ft. vertical shaft was sunk through two layers of lava, interspersed with gravel. A 45-ft. crosscut was driven south, encountering 2 ft. of gravel which is said to have shown color. All operations stopped in November, 1935, when a 220-ft. crosscut northward through cobbles reached what was thought to be a rim of a channel, but it is understood that this is the end of the property line. The main primary channel courses almost eastward, and the above work was to crosscut the channel. Equipment includes a 120-cu. ft. Gardner-Rix compressor and a Fairbanks-Morse single-drum hoist, both driven by gasoline engines; and a double-action pump.

Operations were resumed on this property in May, 1936, under the assumption that the shaft lay on an island between two channels. Work will be confined to the south, in hopes of encountering a channel. It is understood, from reliable sources, that the mine is on the south rim of the main primary channel, often called the Central Hill Channel, and that possibilities are slight in finding a channel to the south.

Golden River Mining Company, 915 Transamerica Building, Los Angeles, is working the main primary channel above the Vallecito Western mine, about 5 miles northeast of Angels Camp. The operation commenced in July, 1932. The 1250 acres, covering several miles of channel, are owned by the *Thomas B. Bishop Company* (*Bishop Estate*), 166 Geary Street, San Francisco. Roland Rich Woolley is president of the operating company, and T. Sturla, mine superintendent.

The channel courses almost due west. The gravel is partly cemented and contains a considerable number of boulders. The bedrock varies, but is mainly granite. Development includes a 300-ft. three-compartment shaft through a volcanic ash capping and gravel to bedrock, from which the channel has been drifted and crosscut for about 1500 ft. up-stream. The property is still in the development stage, but a little breasting has been done. Some of the early work is said to have been down-stream, but the large flow of water gave considerable trouble and all operations were confined up-stream. About 150 miner's inches of water is now lifted with a centrifugal pump, which water is used in the washing plant. An emergency pump is also available.

There are separate bins for the waste rock, and for the coarse material from the end of the trommel, which is trammed to the dump. The washing plant consists of a trommel for disintegrating the partly cemented gravel. The screened material is washed down a long sluice, lined with riffles. There is an electric hoist and air compressor. From 25 to 30 men are employed.

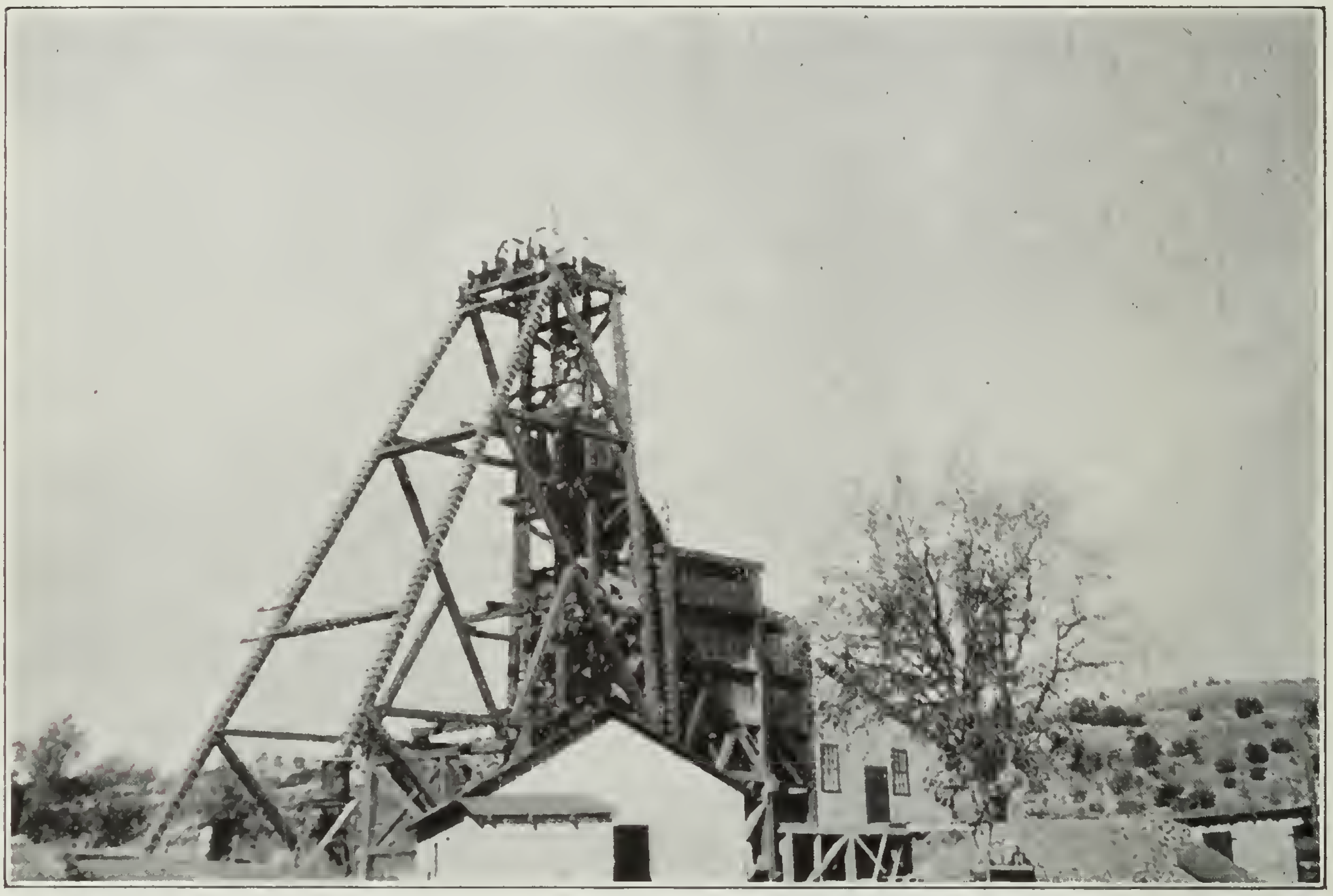


FIG. 23. Headframe and washing plant at Golden River Mine.

Green Mountain, formerly *McSorley Mine,* adjoining the *Rough Diamond Placer Mine,* 2 miles south of Mokelumne Hill, is owned by R. P. M. Davis, 6715 Hollywood Blvd., Los Angeles. The holdings include the Crystal, Green Mountain, and Green Mountain Extension No. 1, 2, and 3 claims. They are on the Tunnel Ridge channel, which courses southwest. The width of the channel is from 100 to 200 ft., with a depth of gravel from 6 to 12 ft. There are many old workings, some of which have caved. This property is known for its production of large quartz crystals, as well as for gold. The crystals from this mine were much in demand because of their large size, clearness, and flawless character. They have been used for jewelry, in lenses, in radio work, in optical instruments and for many other purposes where fine crystals are needed. J. J. McSorley, the former owner, last operated the property for quartz crystals in 1934.

Haupt Ranch, owned by N. B. and L. F. Haupt, Valley Springs, is 5 miles west of San Andreas. W. D. Hicks, 210 South Eucalyptus Street, Inglewood, last operated on this property in October, 1935. He is said to have sunk a 400 ft. vertical shaft to the north rim of the gravel channel and had commenced to crosscut the channel westward when he abandoned developments.

Hexter Placer Mine, 1½ miles southeast of Mokelumne Hill, on the northwest slope of Stockton Ridge, is on the Duryea Channel. The property has been worked for the gold in the gravels and for the opals found on the property. However, the opals are too soft and are not used as gem stones. Old workings include a 2000-ft. tunnel driven in the diorite bedrock underneath the rhyolitic and andesitic capping to the channel, that forms the crest of Stockton Ridge. The channel was drifted on for a distance of 500 ft. north and 500 ft. south. Report XIV states that the pay gravel was 150 ft. in width and 7 ft. in depth. It was slightly cemented. Idle. Mrs. T. Fershstand, San Francisco, and J. J. McSorley, Mokelumne Hill, owners.

J. D. M. Mine, on old Manuel Ranch, in Sec. 12, T. 4 N., R. 10 E., and Secs. 7 and 18, T. 4 N., R. 11 E., 1½ miles northeast of Valley Springs, now owned by Chas. P. Snyder, San Andreas, is being operated by J. D. McCord and Wm. D. McKendrick of Valley Springs. A 300-ft. vertical shaft has been sunk in the lava, but the gravel channel has not yet been reached.

Lancha Plana Gold Dredging Company, Lancha Plana, plans to commence dredging operations on the G. B. Podesta ranch, formerly Hills ranch, in the spring of 1936. This dredging site of approximately 200 acres is 2 miles west of Camanche, just south of Mokelumne River, in Secs. 10 and 11, T. 4 N., R. 9 E. C. G. Patmon is president and H. L. McPherson, secretary of the company.

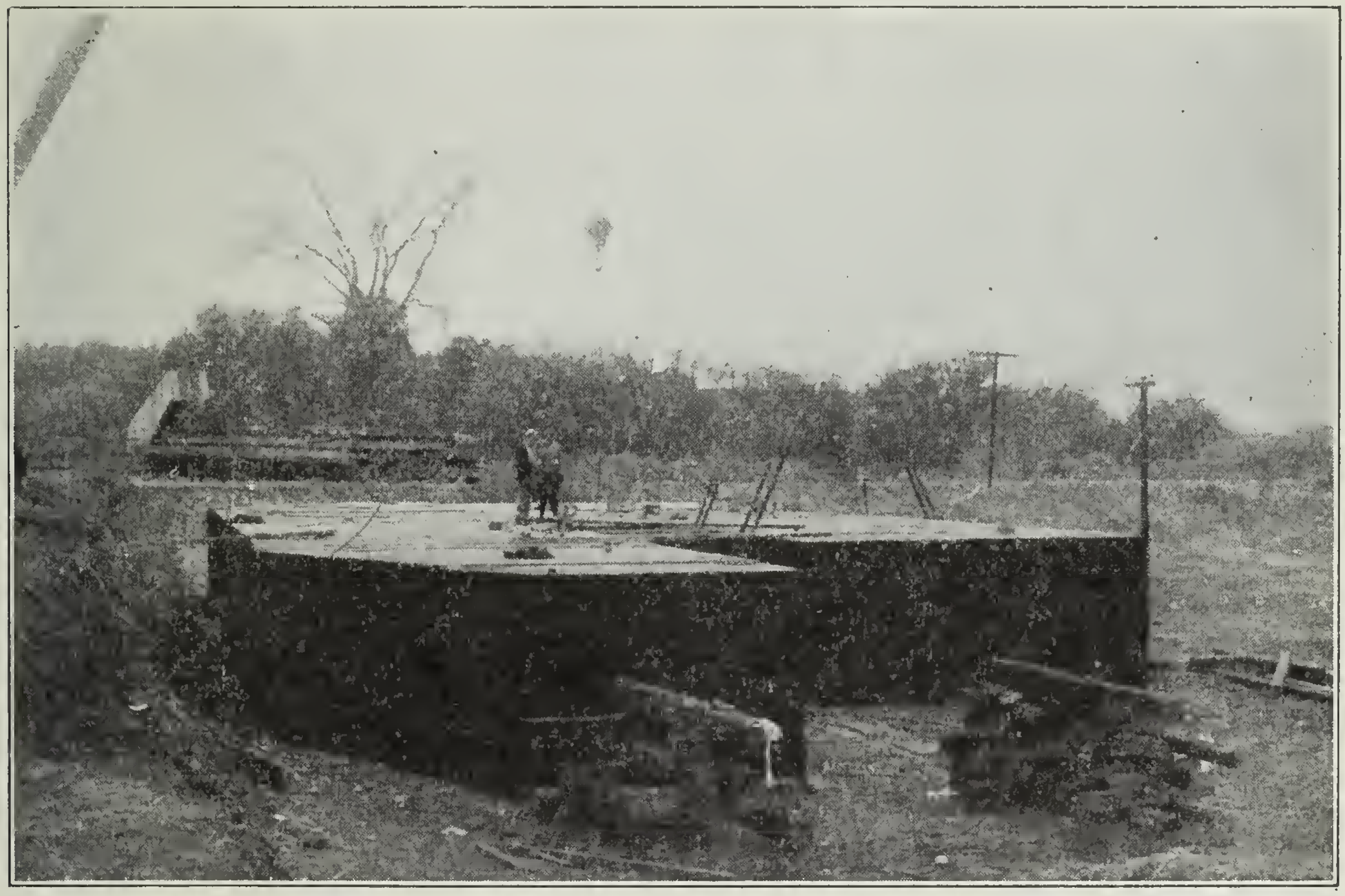


FIG. 24. Assembling steel pontoons for hull of dredge of Lancha Plana Gold Dredging Company.

The average depth of the auriferous sand and gravel is 20 ft., and it is overlain in places by a thin loam up to 6 ft. in thickness. The bedrock is of soft clay. When the property was visited in January, 1936, the company had fifteen men employed in erecting the 27 steel pontoons built by Yuba Manufacturing Company. The new dredge will have 82 buckets of 6-cu. ft. capacity each. The hull will be 101 ft. long, 44 ft. wide, with a depth of 8 ft. 1 inch. The digging ladder is to be 74 ft. 6 inches long. The total connected electric load will be about 450-h.p. The company hopes to dredge 1½ million cu. yds. a year, or about 3500 cu. yds. a day

Latimer Gulch Mine, formerly *Benson Gravel Mine,* is 7 miles by road northeast of Valley Springs; Thomas B. Jackson, San Andreas, owner. The Kreamer and Deep Blue Lead channels are said to course west on this property. Martin Reinking, San Andreas, leased the mine in July, 1932, and works the property alone. He states that the development downstream consists of a 500-ft. tunnel driven west, followed by a flat 200-ft. incline south, from which there is a 150-ft. drift west, followed by a 150-ft. drift southwest. All of this work is on the Benson 'flow,' a small channel about 100 ft. above the Deep Blue Channel. There is an average thickness of 5 ft. of gravel, cemented together with sulphides. The values are found as free gold and as sulphides. Large boulders occur. There is a lava bed-rock. None of the cemented material has yet been treated. Equipment includes gasoline-engine-driven Ingersoll-Rand 110-cu. ft. compressor, air hoist, Ingersoll air tugger and a Worthington pump.

Lava Cap Drift Mine is located 4 miles east of Murphys. W. P. Hofstetter, Murphys, has leased the 40-acre property from H. W. Herliky, 816 So. Figueroa St., Los Angeles. Present operations commenced in November, 1934, in an effort to mine the Cataract channel, which courses southwestward. Development includes a 500-ft. tunnel driven N. 65° W., from the end of which a 125-ft. inclined (57°) raise was driven to the rim of the channel. A 100-ft. drift was driven between the end of the raise and above the tunnel in an endeavor to strike the channel at a lower elevation, but this was also too far up on the rim. The 500-ft. tunnel is now to be extended for 200 ft. in order to reach the trough of the channel. Equipment includes a 130-cu. ft. Ingersoll-Rand compressor, driven by a gasoline engine. Four men are employed.

Lloyd Mine, formerly *Watson Brothers Placer Mine,* 4½ miles by road northwest of San Andreas, is owned and operated by Gordon Scheckler, 614 West Acacia Street, Stockton. E. B. Crouch is superintendent. Operations have continued since the fall of 1932.

This mine is on the Central Hill or San Andreas Channel, which courses north. Recent operations in the northward drifting have disclosed a cross channel, coursing N. 20° W., with bedrock 7½ ft. lower than the old channel. Most of the gravel is loose, although the roof or top gravel is slightly cemented. The width of pay gravel is about 250 ft., with an average depth of 6 ft. The Central Hill channel gravel consists mainly of white schist, slate, and flat quartz stones.

A 300-ft. shaft has been sunk on an incline of 33°, passing through a formation of gravel, then a lava capping, to the channel gravel. A drift has been driven north, downstream of the Central Hill channel, for approximately 800 ft. The slate bedrock is tilted up on the northern end of this drift about 10 inches to every 100 ft., and work is actually up grade. Considerable breasting has been done on the west rim of this drift, and some ground to be breasted remains, just southwest of the cross channel. The last development consists of about 200 ft. of drifting north from the end of the 800-ft. drift, on the cross channel which has come in from the southeast. The cross channel gravel consists mainly of rounded cobbles, composed of diorite and quartz. Plans are to explore the northeast rim of this cross channel by means of a crosscut near the foot of the inclined shaft, or to sink a new shaft on the east side of the hill.

A gasoline-engine-driven hoist is used to haul the 1-ton skip up the incline, where the gravel is dumped into a 50-ton capacity gravel bin. The gravel is then washed and screened in a 14-ft. trommel followed by a 12-ft. sluice lined with Hungarian and wooden riffles. The coarse rock from the end of the trommel is elevated by a 30-ft. belt conveyor to a tailings bin, from which it is hauled away by truck. Other equipment includes an air compressor and jack pump driven by a Holt fuel-oil engine. The mine makes only about 5 gallons of water a minute, an amount insufficient for the gravel to be washed—62 tons, daily. A total of 14 men are employed one shift, including 10 underground.

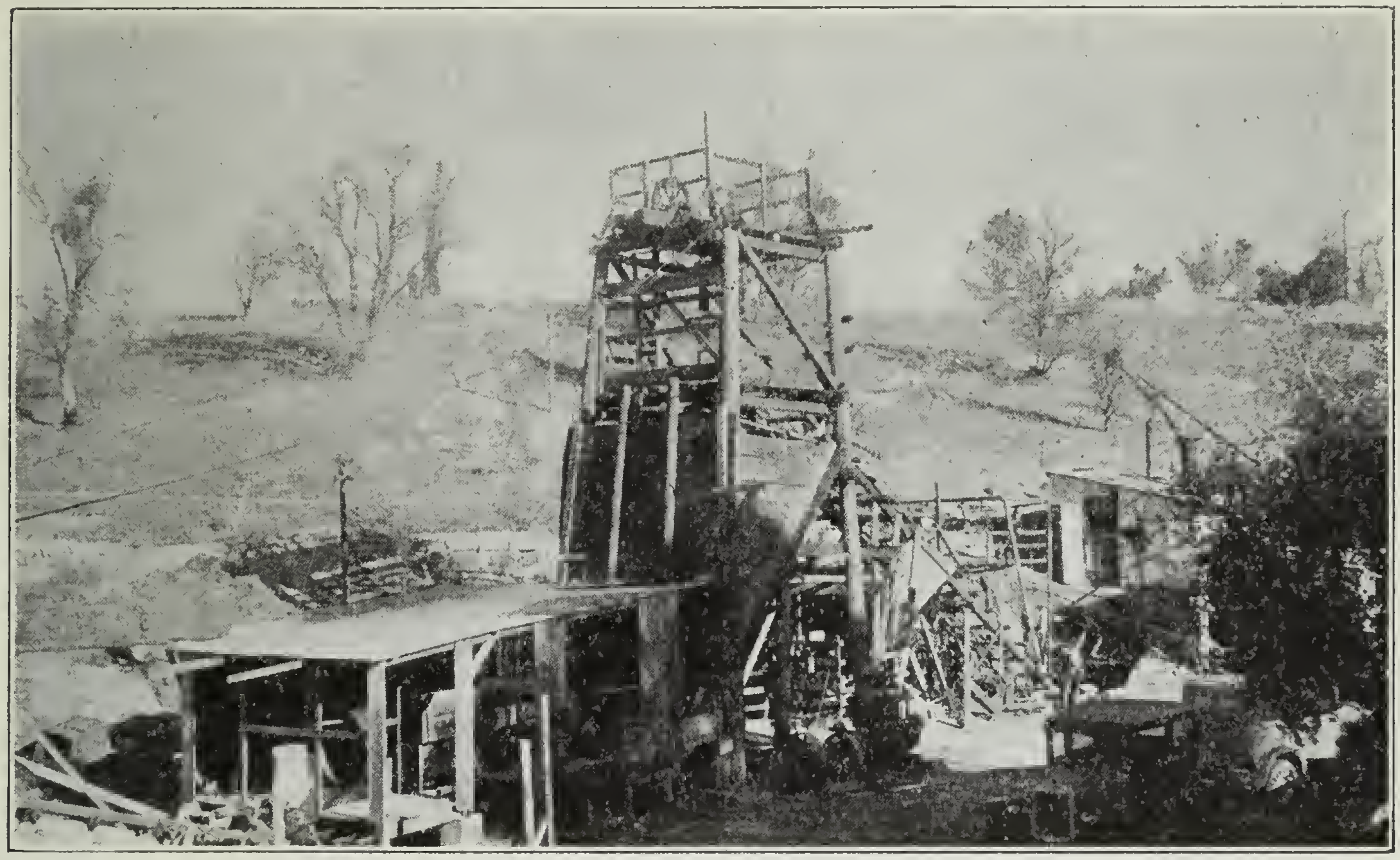


FIG. 25. Washing plant and headframe at Lloyd Mine.

Lombardi Mine, about 4 miles south of Mokelumne Hill alongside the main highway, is said to be situated on the Deep Blue Lead Channel. Lombardi Brothers, Mokelumne Hill, owners, commenced developing the property in January, 1936. A 27-ft. vertical shaft has been sunk through lava to slate bedrock. A 42-ft. crosscut had been driven eastward from the bottom of shaft into 20 ft. of gravel in May, 1936. The gravel is firmly packed, contains large boulders, is about 7 ft. in depth. The washing plant consists of a 9-ft. by 30-inch trommel with 24 ft. of riffled sluice. Other equipment includes a hoist and 1½-inch rotary pump, all being driven by gasoline engines. Three men are employed in the prospecting work.

Milton Gold Dredging Enterprise, owned by K. G. Schwegler, 405 Montgomery Street, San Francisco, has a dragline dredge on the Robie Ranch, 2½ miles northwest of Milton. L. Hadley is superintending operations, which started in September, 1935. The gravel deposit has an average depth of about 7 ft., and is thought to test about 25 cents per cu. yd. The bedrock is volcanic tuff. Portions of the gravel are lava capped, and in a few places the gravel is partly cemented.

The floating washing plant is built on a wooden hull that is 40 ft. long by 37 ft. wide, with a depth of 29 inches. The 54-inch by 28-ft. trommel has 16 ft. of screening and 8 ft. of scrubbing section. The cobbles from end of trommel are stacked by means of a 49-ft. conveyor belt. The material washed through the ⅜-inch holes in the screening section passes over 36 ft. of sluice on either side of the trommel, which is lined with angle-iron riffles. A 37-B Bucyrus-Erie 60-h.p. electric shovel, with 50-ft. boom and 1½-cu. yd. bucket, scoops the gravel and dumps it into the hopper of the washing plant. A 50-h.p. motor drives the pump which supplies a stream of water for washing the gravel in the trommel. Water is purchased and brought down a dry creek from the Salt Spring Reservoir. A 30-h.p. motor drives the trommel and stacker. The gold is cleaned at intervals from the 7 sluice boxes (12 ft. long by 26 inches wide), by means of a long tom and quicksilver trap. From 2000 to 3000 cu. yds. of gravel is treated daily. Three men are employed on each of the three shifts daily.

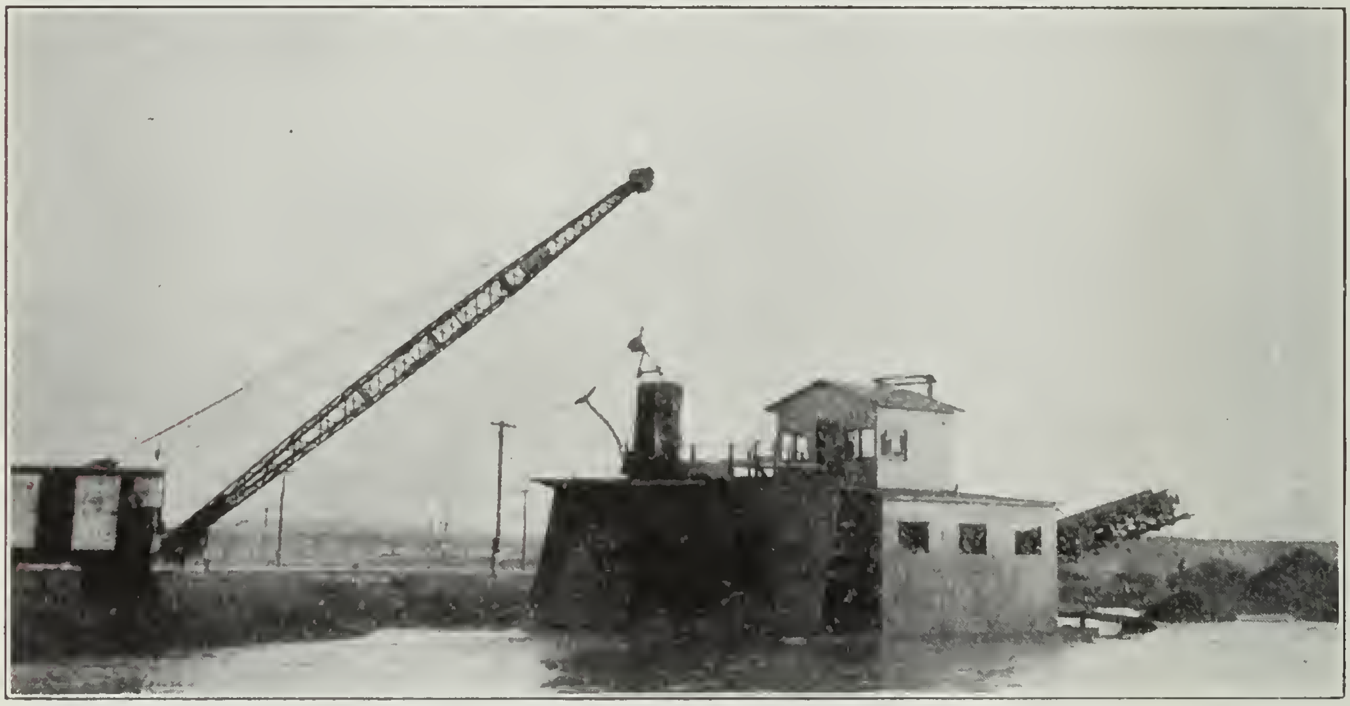


FIG. 26. Milton Gold Dredging Enterprise's dragline dredge.

Old Stiff Mine is 3 miles southeast of Vallecito, adjoining the old Sloane and Fine Gold hydraulic mines. A partnership consisting of Pearl W. and J. A. Mattly, Ed Deaver and A. R. Brossard, Vallecito, have leased this 182-acre patented property from the Halpert Estate, c/o Hubbard, Hubbard and Hayden, Attorneys, Rowell Bldg., Fresno. The present operators, who commenced in August, 1935, are to drive an 800-ft. tunnel into the side of the hill in order to get under the Columbia or Cataract channel. They were in 275 ft. when visited in November, 1935. The gravel is thought to be slightly cemented. The channel courses southwestward. Four men were working, using hand tools. Country rock is a soft, decomposed limestone.

The nearby *Sloane mine* is being prospected by a Mr. McDermott of Vallecito. There is an inclined shaft, down about 200 ft. Three men are employed.

Oro y Plata Tailings have been leased from the *Union Consolidated Mining Company* by the *Orion Company,* 1022 Crocker Building, San Francisco. The principals in the company are Philip R. Bradley, Jr., and Hank Bradley. Erick Puschmann is foreman. From 18,000 to 25,000 tons of tailings are thought to be available, mainly from the operations of the Oro y Plata mill in the 80's, and a small amount from the 1926–1932 operation.

Construction of a counter-current cyanide plant commenced in April, 1936, and it is planned to start treating the tailings early in July, 1936. Five men were employed in constructing the 100- to 150-ton plant in May, 1936. The plant will consist of one 16 by 16-ft. agitator, a series of four 750-barrel thickener tanks, and zinc box precipitators. It is planned to mine and dump the tailings by dragline into a 50-ton ore bin, from which the material will be fed by conveyor belt to the agitator. Electric power will be obtained from the Oro y Plata mine transformer and water will be secured from the Utica Mining Company's ditch.

Oversite Mine, on *Brugger Tract,* 2800 ft. northeast of the Vallecito Western mine shaft, a few miles northeast of Angels Camp, was worked by the *Oversite Gold Mining Company* from 1928 to 1931, when operations ceased on account of lack of capital. Another channel is thought to intersect the Central Hill channel on this property. The above-mentioned company sank a two-compartment vertical shaft 256 ft. to the station on bedrock. The Central Hill channel was then crosscut and drifted on for approximately 2200 ft. mainly upstream. A great portion of these workings were in the slate bedrock, raises being driven up to tap the gravel at various places. A depth of as much as 60 ft. of gravel was found, but most of the gold was on bedrock or in the 3 ft. of gravel above it. A small production of gold was realized. P. DeMichels, Angels Camp, has an option and lease on the 40-acre property, and contemplates reopening the mine. Victor Lemoge, 281 Natoma Street, San Francisco, former secretary of the Oversite Gold Mining Co., is trustee for the stockholders of the former company.

Poe Placer Mine, ¾ mile north of Railroad Flat, is owned by Edgar Poe and Daly Jones of Railroad Flat. A Mr. Roe, with the Stanley Electric Co. of Stockton, is said to have last worked the mine for 3 months during the winter of 1934. The channel is developed by a 200-ft. inclined shaft.

Porteous Mine, is situated 4 miles south of Mokelumne Hill. Mervin Porteous, Mokelumne Hill, is the owner. Hal W. Niswagner, Osborn, Kansas, is said to have taken an option on this old drift property. Two tunnels, 400 and 500 ft. in length, are said to have been recently cleaned out and retimbered. The property is on the Tunnel Ridge Channel. An old Cox pan-mill is at the mine.

Purinton Mining Company, Box 235, Angels Camp, owns portions of the *Jack Rabbit, Bonanza, Amazon* and *Lundt* placer claims, located about 2½ miles north of Angels Camp. Frank Purinton, 225 Fell Street, Apt. 12, San Francisco, is president of this concern, which unwatered and sampled this channel property about 1930, in which the Central Hill channel courses N. 75° W. Development is said to include a 50-ft. inclined shaft, from which a 1400-ft. tunnel was driven southward to the trough of the channel. The channel was then drifted on about 600 ft. east and 300 ft. west. The gravel is strongly cemented, and contains many boulders. The bedrock is slate and greenstone. The mine made about 10 miner's inches of water. The gravel is said to have averaged better than $4 per cu. yd. No equipment remains on this idle property.

Rough Diamond Placer Mine, adjoining the Eclipse mine to the west, in Secs. 24 and 25, T. 5 N., R. 11 E., 2 miles south of Mokelumne Hill, is owned by J. J. McSorley, Mokelumne Hill. It is on the Tunnel Ridge Channel. Old workings include a 700-ft. tunnel. Quartz crystals are also said to be found here in the sand and gravel. The owner expects to have this property in operation in the near future.

Safe Deposit Mine, on Red Lead channel in Old Woman's Gulch, is about 2½ miles south of Mokelumne Hill. B. M. LaFontaine and George Apperson of Dixon leased the 40-acre property from R. Snavely, Mokelumne Hill, owner, and commenced working it in August, 1935. The channel courses southwest. The exposed gravel, partly cemented, is mixed with clay, and is from 60 to 80 ft. in depth. The clayey gravel is loosened by a scarifer pulled by a 40-h.p. diesel tractor. The gravel is then moved to the washing plant by means of a scraper pulled by a gasoline-engine-driven winch. A bucket conveyor hoists the gravel to a 6-by-12-ft. trommel. The course material is stacked by a 20-ft. conveyor belt, while the screened material is washed down an 18-ft. sluice lined with Hungarian riffles. From 50 to 75 cu. yds. of gravel is washed daily, and is said to run about 50¢ a cu. yd. From 2 to 4 men are employed, under the direction of J. P. Gomez.

San Domingo Mine, owned by the *Pacific Gas and Electric Company,* is leased by R. G. Hotchkiss and F. Huntington Clark. This gravel property, located in Secs. 7, 8, and 17, T. 3 N., R. 13 E., 3 miles northeast of Altaville, was hydraulicked in the old days. The present operators, who commenced in the fall of 1934, are prospecting the mine upsteam through a 600 ft. tunnel, driven N. 71° E. The Central Hill channel courses almost due west. The small amount of water is drained through the tunnel. The gravel is slightly cemented, and contains some boulders. There is a rough slate bedrock. From 18 inches to 2 ft. of bedrock is mined and treated in the washing plant. The gravel and bedrock material is lifted from the tunnel's track-level by a 36-ft. bucket conveyor to a 25-ton gravel bin, whence the gravel is washed by a 4½-by-18-ft. trommel, the lower 5 ft. consisting of screening. The screened material is washed down a sluice box containing wire screen, burlap and Hungarian riffles. The coarse material is stacked by a 60-ft. conveyor belt. Other equipment includes electric motors and a Gardner compressor. Three to four men are employed.

Slab Ranch Property was worked by the *Calmo Mining and Milling Company,* also known as the *Mound City Mining Company,* about 1932. This property is on the Central Hill channel, adjoining the Calaveras Central Mine to the east, about 1½ miles east of Angels Camp. The *Calaveras Central Gold Mining Co., Ltd.,* recently obtained control of the property, but they have not yet commenced any development of it.

The former operators sank two vertical shafts, 167 and 115 ft. in depth, from which they are said to have driven several thousand feet of drifts and crosscuts, both up and down stream, and in country rock. Their operation is said to have been a failure due to the impractical mining methods used. Some of the workings are said to have been in gravel, but above bedrock, and the trough of the channel was not explored. Workings are also said to have extended into the country rock in search of quartz stringers, instead of exploratory work on the channel.

Bibl.: State Mineralogist's Report XXI, p. 161.

South Fork Mines, Inc., is working a gravel property 4 miles by road west of San Andreas on the South Fork of Calaveras River. It was subleased to George C. Kelber, 260 California Street, and Robert Burnham of San Francisco, principals of the operating company, by Luke Cepenich of Altaville in February, 1936. The land was known as the *Preston property,* but is now owned by F. Winkler, San Andreas.

The compacted gravel is mixed with a little sand and clay. There are few boulders. There appear to be three distinct gravel channels, and the deposit is evidently the remnant of an ancient channel or old benches of Calaveras River. Two of the channel runs have a total width of 350 ft. of gravel, from 26 to 40 ft. in depth. It has a slate bedrock. The deposit was worked about 15 years ago by means of three shallow shafts and two tunnels. Cepenich states that the gravel tests $3 a cubic yard.

The present operators had 10 men employed in May, 1936, erecting equipment. The gravel is to be mined by means of a Koehring gasoline shovel of ⅝-yd. capacity and dumped into the hopper of the washing plant, which is movable on railroad tracks. A conveyor belt will feed the gravel to an 18-by-4-ft trommel. Screened material will be washed down a sluice lined with riffles. The rejects will be stacked by means of a 100-ft. conveyor belt. The trommel and two pumps will be driven by gasoline engines. It is expected to treat 600 cu. yds. a day, running two shifts.

South Gulch Dragline Dredge, 3 miles south of Jenny Lind, is operated by E. L. Lilly, 1844 Carmel Avenue, Stockton. This operation started October 20, 1934. Forty-four of the 60 acres had been worked when visited early in December, 1935. This South Gulch Creek gravel deposit is about 300 ft. wide and 7 ft. in depth, of which three-fourths is not cemented. Bedrock consists of a soft clay. It is necessary to clear away many boulders and some small timber preceding operations, which is accomplished by means of a 60-h.p. caterpillar tractor.

The washing plant is mounted on a wooden hull, and consists of a 20-ft. trommel, and sluices lined with Hungarian riffles. A 50-ft.

belt conveyor stacks the cobbles from the end of the trommel. The plant and pump are driven by a 47-h.p. diesel engine. The gravel is mined and loaded into the hopper by a 68-h.p. Northwest diesel dragline shovel, with 40-ft. boom and 1¼-cu. yd. bucket. It is stated 1200 cu. yds. is the volume treated daily. Four men are employed for two shifts a day. The gravel is said to average 22 cents per cu. yd., while costs are estimated to be 12½ cents per cu. yd. Water for operations is purchased from the Salt Spring Reservoir.

Spring Valley Mining Co., or *Baumhogger Property,* is located 1¾ miles east of Valley Springs. John C. Baumhogger, Bloomfield, Sonoma Co., owns about 120 acres of partly cemented gravel ground, said to run up to $1.50 per cu. yd., and which is from 12 to 80 ft. in depth.

A. R. Folsom, R. F. D. No. 3, Box 133, Stockton, operated the property under the name of the Spring Valley Mining Co. off and on for a few years, ceasing in 1934. A steam shovel was used to mine the gravel, loading the material on a truck, which hauled the gravel to the washing plant. Mining was carried on in the summer, and the gravel washed in the winter and spring when sufficient water was available. The auriferous gravel was mined to a depth of 15 ft., and bedrock was not reached at this particular locality. The owner states that a Mr. Tyler of Jenny Lind plans to rewash the tailings, as the old washing plant, consisting of a trommel with a piece of angle-iron inside, and sluice, did not recover all of the gold values. A production of $12,280 is said to have resulted from two months washing.

This alluvial gravel, which runs in a northeast direction, is also said to continue to the adjoining ranch owned by Mrs. Lizzie Reinking. The owner states that shallow ground water is available, or water may be pumped 1¼ miles from Calaveras River by elevating it 300 ft.

Square Head Mine, or *Chris Anderson Mine,* consisting of 20 acres, is located 1½ miles by road southeast of San Andreas, adjoining the Buck Bros. Mine. Mrs. Hattie E. Hertzig, San Andreas, owner, leased the property to M. James Kennedy, Riverside, and associates, in December, 1935. This old drift mine is on the Fort Mountain or Central Hill Channel, as the two channels join as one in this vicinity. The channel is capped with a breccia of basaltic and andesitic pebbles. An old 100-ft. vertical shaft connects with a tunnel driven in bedrock of soft slate for 450 ft. and 100 ft. in blue cemented gravel. Report XIV of the State Mineralogist states that a 150-ft. width of pay gravel, with a depth of 7 ft., was formerly mined. It also states that the width of the channel is 280 ft., depth of gravel being 63 ft. The owner states that when this property was last worked about 31 years ago, 450 ft. of breasting was done, and the property produced over $360,000, not including gold that was 'high-graded.' The new operators have reopened the 100-ft. shaft and have drifted 40 ft. southwest in old workings. Five men are employed.

Stockton Hill Mine, in the southern part of the townsite of Mokelumne Hill, was leased and operated in 1935 and until February, 1936, by E. S. Jackson and John Cash. It is owned by C. G. Nuner, Mokelumne Hill. The property is on the Stockton Hill or French Hill Channel. The last development includes a 104-ft. vertical shaft on the west rim of the channel, from the bottom of which drifts and crosscuts were driven 90 ft. east, 55 ft. north, and 30 ft. south. This channel is said to have been extensively worked in the early days, but most of the old workings have caved. The gravel is tight, and contains considerable blue clay and a number of boulders. The bedrock is hornblende schist. The mine makes very little water. Equipment remaining on property includes a sluice, trommel, and a hoist driven by a gasoline engine.

Temple City Mining Company, Inc., Temple City, California, leased 25 acres of bench gravel ground, 4000 ft. along the north bank of Calaveras River, from H. T. Hunt, Jenny Lind, in September, 1935. Officers of the company are: a Mr. Ward, president, Alhambra, and Thornton Smith, secretary and manager. The deposit is 2½ miles by road west of Jenny Lind. Portions of the property are lava-capped. The upper 6 ft. of gravel is cemented, while the lower 18 ft. is of loose material. The gravel is said to test 30 cents a cu. yd.

A movable washing plant, mounted on double tracks, was being constructed when visited in December, 1935. A Bucyrus-Erie steam shovel, with ¾-yd. bucket and 22-ft. boom, will dump the gravel into a 5-ton hopper on the washing plant. From hopper the material will be washed over a 3-by 12-ft. shaker screen, under which there is cocoa matting and screen, bordered by 50 ft. of sluice lined with Hungarian riffles. The washing plant is to be powered by a 30-h.p. Russell gasoline engine. A Myers centrifugal pump, driven by a 40-h.p. gasoline engine, will supply the water from Calaveras River. Six men are employed on construction of the washing plant.

Vallecito-Western Mine, owned by the *Thomas B. Bishop Company (Bishop Estate),* 166 Geary St., San Francisco, is being operated under option and lease by the *Tonopah Belmont Development Company,* 501 Bullitt Bldg., Philadelphia, Pa. C. A. Heller is president and J. K. Kitto is secretary of the latter concern. Frederick Bradshaw, Angels Camp, is superintendent. The property, consisting of about 400 acres, is located along 2 miles of a main primary channel, in portions of Secs. 23, 24, and 26, T. 3 N., R. 13 E., approximately 2 miles northeast of Angels Camp, on Six Mile Creek. The Tonopah Belmont Development Co. acquired the mine the latter part of 1932 from the *Vallecito Western Mining Co., Inc.,* who commenced prospecting in May, 1923, and completed the present shaft in 1925.

At this mine the ancient auriferous channel courses N. 60° E. and east. A 156-ft., 1½-compartment shaft, sunk just north of the actual channel, passes through a rhyolitic tuff capping interspersed with sand and gravel before reaching slate bedrock. About 4000 ft. of channel has been worked upstream by breasting and stull stoping. Some small faults, and one major fault about 3000 ft. northeast of shaft, have been encountered. The gravel is largely loose, although there are some layers of cemented material. Very large boulders are found. The values are found in the channel's main trough and on the south rim. Breasted ground averages about 55 ft. in width, ranging from 15 to 125 ft. The depth of gravel varies from 15 to 70 ft. Most of the gold in the gravel is within a few feet of bedrock, and in places where the bedrock is very ragged, two or more feet of bedrock is mined. The gold is often down in joint planes of the granitic bedrock. The character of bedrock differs in portions of the mine, but is mainly slate, amphibolite schist and granodiorite. The grade of the channel varies from 50 to 200 ft. to the mile. The gold recovered has been coarse, ranging from 5 oz, nuggets to pieces 25¢ in size and smaller. Very little black sand accompanies the gravel. Water encountered varies, but averages about 70,000 gallons per day. At the shaft there is a Sterling centrifugal pump and a spare Bean pump.

The gravel is hand shoveled into 1-ton (20-cu. ft.) cars, and 4 cars to a tram are hauled by a storage battery locomotive to the shaft. The 1½-ton skip raises the gravel to the top of the 80-ft. headframe, where it is dumped into a 75-ton gravel bin. The waste and gravel are trammed separately and delivered to different chutes on the surface. The capacity of the transportation system and the mill is 80 tons per day. When visited, November 18, 1935, 30 to 40 tons of gravel was being treated daily in the washing plant.

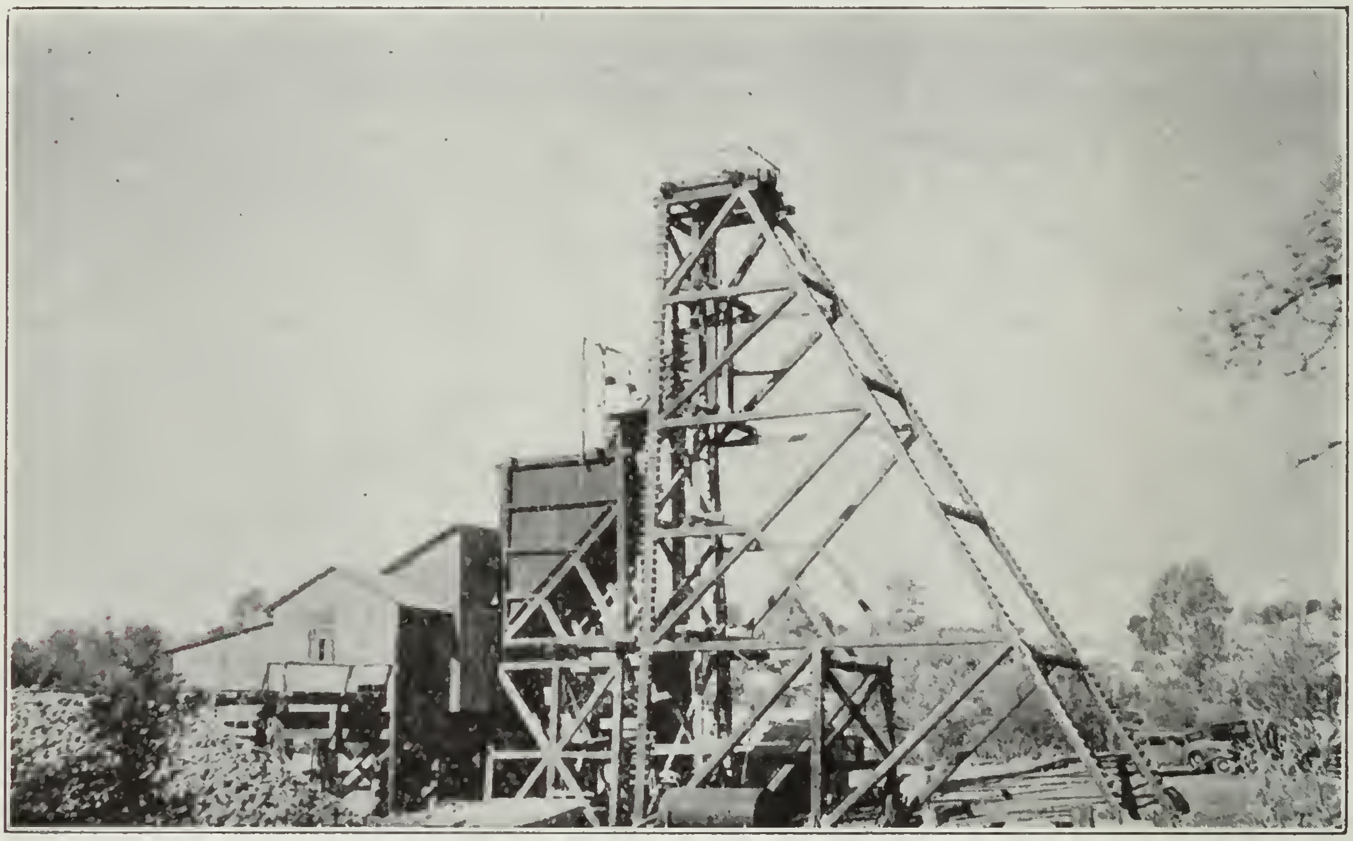


FIG. 27. Headframe and washing plant at Vallecito-Western Mine.

The gravel from the shaft bin is washed by water from a 2-inch line through the bin gate, into and through an 11-ft. Hungarian-riffled sluice, set at a slope of 2 inches per foot. From the lower end of this sluice the gravel discharges into the hopper of a 3- by 18-ft. trommel, set at right angles to the line of sluice. The two compartments of this trommel consist of one for washing and disintegrating, and the second for screening and further washing. The final oversize material passes over a 60-ft. steel-lined sluice, 6 ft. of Hungarian riffles, 100 ft. of pole riffles, and then to the waste dump. The final undersize screened material (minus ⅜-inch) passes, in their respective order, over 4 ft. of Hungarian riffles, 3½- by 6½-ft. screen table, 20 ft. of Hungarian riffles, two 6- by 12-inch baffle plates, 12 ft. of Hungarian riffles, and then joins the coarse discharge of the trommel at the head of the pole riffles, which finally goes to tailing dump on Six Mile Creek. The washing plant requires about 500 gallons of water per ton of gravel treated, or about 3.7 cu. ft. of water per cu. ft. of gravel. Sixty per cent of the total and practically all of the coarse gold is recovered in the first 11-ft. riffle immeditely below the gravel bin.

Equipment, other than already mentioned, includes electric Hendry-Bolthoff hoist, driven by a 50-h.p. motor; 250-cu. ft. Ingersoll-Rand compressor, driven by a 60-h.p. motor; and blacksmith shop. From 20 to 30 men are employed.

In 1934, 2729 oz. of gold was produced from 16,143 tons of gravel mined. The direct cost of mining and milling, including considerable development work, was $3.18 per ton in 1934.

Bibl.: State Mineralogist's Report XXI, p. 161. U. S. Bureau of Mines Information Circular 6612.

Vandervoort Mining Company has a bond and lease on the patented homestead of James A. Redding, Altaville, located east of Vallecito, in Sec. 29, T. 3 N., R. 14 E. T. Vandervoort, Sr., is president, and T. Vandervoort, Jr., Vallecito, secretary-treasurer of the company. The Columbia, Cataract and a side channel are said to traverse this 96-acre ranch, coursing south. The present operators have been working the property off and on since 1933. Development consists of a 250-ft. vertical shaft, which passed through a capping of andesite, latite, and rhyolitic tuff, but had not reached bedrock. A 50-ft drift east on the 240-ft. level encountered 12 ft. of gravel on the west rim of a channel, believed to be a tributary to the Columbia Channel. When visited in November, 1935, the mine was full of water, and L. A. Woodworth was employed in making a geological survey of the property. The company plans to crosscut the channel encountered, prove the eastern rim, and then sink to bedrock. Equipment includes a 13-stage Budlong-Campbell turbine pump, driven by a gasoline engine.

West Mine, on the *Schwerer Ranch,* at Murphys, is leased to Robert E. Lowther, Buffalo, N. Y., agent for *Precious Metals, Inc.* William W. Thayer, 1352 Van Ness Avenue, San Francisco, is manager of the organization's California division. W. C. West, Murphys, is to be mine superintendent if operations are commenced. The property is said to be on the Central Hill Channel. Mr. Thayer stated that a 15-inch test-drill hole had been sunk through the limestone capping to the gravel, and plans were to sink an incline shaft to the bottom of the deposit. Apparently the gravel lies in cavernous limestone or there has been some faulting. An electric hoist, gravel bin, sluice, and Chicago pneumatic air compressor are on the property. An attempt to treat the gravel with the present plant, by elevating the sand and gravel to the gravel bin by pump through a long pipe, is said to have previously failed.

Western Placers, Inc., a Washington corporation, 1130 Broadway, Seattle, has an option on 140 acres of channel gravel in Happy Valley, at the head of Chili Gulch. This is part of the *Paul P. Lancell property,* 1 mile east of Mokelumne Hill, which was hydraulicked many years ago. Hugh Swartz is president of the company, and J. C. Burgess of Nevada is mine superintendent. Some equipment had been hauled on the property when visited in November, 1935, but difficulty was being had in obtaining water from the nearby Mokelumne ditch, and no actual mining had commenced. It is planned to work the gravel by sluicing, removing the tailings by means of two draglines. The gravel is said to average 40¢ a cu. yd.

TABLE OF PLACER MINES AND PROSPECTS, CALAVERAS COUNTY

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Aetna Cons.	21, 22 27, 28	3 N. 3 N.	13 E. 13 E.	Calaveras Central Mng. Corp., c/o Harry Sears, Angels Camp	410	
Aetna Cons.	27	3 N.	13 E.	W. F. Johnson and Tillie Johnson, c/o W. F. Johnson, Altaville	10	
Amalia	27	4 N.	13 E.	Anna H. Hayes, 670 Brooklyn Ave., Oakland	20	
Amazon Cons.	21	3 N.	13 E.	Albert Douglas and Nellie Douglas Williams, Angels Camp, and Purington Mng. Co., Box 235, Angels Camp	70	
Amazon Star	21	3 N.	13 E.	Albert Douglas and Nellie Douglas Williams, Angels Camp	60	
Aros	15	4 N.	10 E.	S. P. Aros, Campo Seco	20	
Arthur	7	6 N.	14 E.	J. P. Arthur, Box 65, West Point	40	
Asbestos & Reynolds Ferry	15	1 N.	13 E.	Oakland Title Ins. & Guaranty Co., 15th and Franklin St., Oakland	40	
Augostini						R. XI, p. 177; XIII, p. 97
Avalanche	21	3 N.	14 E.	John Charles Cox, 2655 Harvey Ave., Fresno	60	R. XIV, p. 114
Austrian Hill	11	4 N.	13 E.	Leonard D. Baldwin, c/o Franklin Baldwin, 1111 Merchants Nat'l Bank Bldg., Los Angeles	30	
Bachelor	18	3 N.	14 E.	Wm. Thomas, Jr., and Mrs. Catherine Miller, c/o W. L. Thomas, R.F.D. 2, Box 106, Los Gatos	20	
Bailey						R. XIII, p. 97
Balaklava	32	3 N.	14 E.	G. C. Tryon Estate, G. M. Tryon and Chas. Tryon, Angels Camp	40	R. XX, p. 6
Balaklava						See Meinecker & Sanguinette
Bald Eagle	24	3 N.	13 E.	Victor Lemoge, 281 Natoma St., San Francisco	40	
Bald Rock	6	6 N.	13 E.	Gertrude McCullough et al., 787 W. Julien St., San Jose	110	
Baldwin Group						See Dollar
Baldwin						See Western
Banner Blue Gravel						See Big Bend
Bard Hill						R. XVIII, p. 99
Barker, Union Shaft & Union Shaft Extension	11	4 N.	11 E.	Frances B. Reed, San Andreas	80	R. XIV, p. 122
Barnhardt	25	4 N.	12 E.	Calaveras Cement Co., Inc., 315 Montgomery St., San Francisco	40	
Bear Creek	1	6 N.	13 E.	Walter R. Wickham, 3305 Elm St., Oakland	20	
Beda Blood	28	3 N.	13 E.	James V. Coleman, Jr., c/o Donahue Kelly Bk. Co., 68 Sutter St., San Francisco	20	
Betty Lode et al.	13, 24 17, 18 19	5 N. 5 N. 5 N.	12 E. 12 E. 12 E.	Frederick H. Rindge, 439 N. El Dorado St., Stockton	20	
Big Bend	13, 24	5 N.	13 E.		155	R. XIII, p. 97; XIV, p. 114

Big Cliff						See Porteous Group
Big Nugget	15	4 N.	13 E.	F. M. Cordtz, Mountain Ranch	40	
Bishop Estate	19, 20 30 6	3 N. 3 N. 2 N.	14 E. 14 E. 14 E.	Thomas B. Bishop Co., 166 Geary St., Whittle Bldg., San Francisco	432	R. XII, p. 99; XIII, p. 122; XIV, p. 123; XIX, p. 18; XX, pp. 6-7
Blue Bell	35	6 N.	13 E.	Elmer H. Jordan, 576 Bellevue Ave., Daly City	20	
Blue Bird & Grey Eagle	12 7	4 N. 4 N.	9 E. 10 E.	Carl Utecht, 209 Kentucky St., Vallejo	40	
Blue Gravel	2	4 N.	11 E.	Henry M. Spinolla and Wm. F. Talmadge, San Andreas	50	
Blue Lead Ext.	18, 19	5 N.	12 E.	Boundary Cone Associates, Inc., 921 Stock Exchange Bldg., Los Angeles, c/o Wm. H. Wise		
Blue Mountain	13, 24	2 N.	11 E.	Frances Rodder, Tonopah, Nevada	33	
Boire	26	6 N.	13 E.	E. Marre, Jackson	64	R. XIV, p. 114
Bonanza	7	3 N.	13 E.	Mrs. Augusta Veeder Thompson, c/o J. F. Leicester, 105 Montgomery St., San Francisco	10	
Bonanza	17	3 N.	14 E.	Purinton Mng. Co., Box 235, Angels Camp	10	
Bonanza						R. XIII, p. 99
Boomerang	28	4 N.	12 E.		60	
Boyd	21	3 N.	14 E.		20	R. XIV, p. 115
Brandy Flat	26	4 N.	12 E.	Marie S. Trenque et al., c/o Mrs. George Saunders, 1923 18th Ave., San Francisco	40	
Brewery Gulch	6	3 N.	14 E.	Chas. P. Hauselt, 750 Baker St., San Francisco	10	
Buckeye Gulch & Vallencia	5, 8	5 N.	12 E.	J. F. Vallencia, Mokelumne Hill	38	
Buckeye & Buckeye No. 2	8	5 N.	12 E.	Theresa Guiffra, Mokelumne Hill	55	
Buckminister						See Uptograph
Buffalo	23, 24 25	5 N. 5 N.	11 E. 11 E.			R. XIV, p. 115
Bull Pine						See Aetna Cons.
Calaveras Gold Dredging Co.		3 N.	10 E.			Bull. 57, p. 207; XIV, pp. 124-25
Calaveras Gravel						See Lloyd Gravel
Calaveras River	31	4 N.	11 E.		25	
Calaveritas Hill Cons.	35	4 N.	12 E.	California Trust Co., 629 S. Spring St., Los Angeles	80	R. XIV, p. 115
Calief & Camou	29, 32 31	1 N. 1 N.	13 E. 13 E.	George G. Gorham and Frank Gorham, Copperopolis	280	
Camanche & Camanche No. 2	12	4 N.	9 E.	John P. Cavagnaro, Camanche	40	
Camanche Dredger	11, 12 13, 14	4 E. 4 E.	9 E. 9 E.	Camanche Gold Dredging Co., 530 Stock Exchange Bldg., Los Angeles, c/o C. E. Gilhousen	240	R. XXI, p. 162
Cape Horn	31	6 N.	13 E.	Calaveras Cement Co., San Andreas	40	
Carpenter	31	3 N.	13 E.	Geo. W. Osborn et al., c/o E. J. Osborn, Altaville	20	
Carpenter	13, 24	5 N.	11 E.		50	R. XIV, p. 115
Cassinelli						See Rising Star
Cataract & Wide Awake	14, 15	3 N.	14 E.			R. XIV, p. 115
Central & Alpha	15, 21 22	1 N. 1 N.	13 E. 13 E.	Stanislaus River Properties, c/o Warner, Stackpole & Bradlee, 84 State St., Boston, Massachusetts	190	
Central Hill	17	3 N.	14 E.		60	R. XII, p. 91; XIII, p. 100; XIV, p. 115
Chain Hill & Swiss	19, 30	4 N.	13 E.	T. Rocchi, San Andreas	42	
Chapman	20, 21	4 N.	12 E.		163	R. XIV, pp. 115-116
Chili Creek	35	5 N.	11 E.	George Edwards, Mokelumne Hill, et al.	60	

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TABLE OF PLACER MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Chili Gulch Tailing & Worth Hill	1, 2	4 N.	11 E.	Jos. H. Huberty, c/o Chas. Snyder, San Andreas	168	
Chili Gulch Chalk Hill	15	4 N.	10 E.	George W. Ryno, Campo Seco	23	
Chispa	30	4 N.	14 E.		357	R. XIV, p. 116
Chris Anderson	21	4 N.	12 E.	Mrs. Hattie E. Hertzig, San Andreas	20	
Clover Leaf	12	5 N.	11 E.		83	R. XIV, p. 116
Coffee-Mill	26, 35	5 N.	11 E.		80	R. XIII, p. 101; XIV, p. 116
Columbo & John McLaughlin P. Mine Tailing	25	4 N.	12 E.	Columbo G. and David Cademartori, San Andreas	40	
Consolidated Marble et al.	1, 3, 4 24 6 36	5 N. 5 N. 5 N. 6 N.	12 E. 12 E. 13 E. 12 E.	Calaveras Corporation, c/o Thos. Jacob, R. B., Box 85, Visalia	560	
Consolidated River	26, 27	3 N.	14 E.	Alfred Gianelli, Glenda L. Mitchler et al., c/o M. H. Manuel, Murphys	90	
Cook	9	4 N.	10 E.	Patrick H. Cook, Campo Seco	40	
Copenhagen	13	5 N.	11 E.		20	
Corral Flat	13	5 N.	11 E.		40	R. XIV, p. 116
Cousin Jack	27	4 N.	12 E.		20	
Crosby	28	3 N.	13 E.		10	
Cultus	25	6 N.	13 E.		20	R. XIV, p. 116
Deep Lead	13	5 N.	11 E.		50	R. VI, pt. 2, p. 29
Deep River	26	5 N.	13 E.	Frank Rosenthal, Mountain Ranch		
Dennis	21	3 N.	10 E.	Wm. S. Dennis Estate, Jenny Lind	20	
Dollar et al.	1, 11 30, 36	4 N. 4 N.	13 E. 13 E.	California Trust Co., 629 S. Spring St., Los Angeles	256	
Dolly Varden				F. Valente et al., c/o D. Copella, Douglas Flat	24	
Duck Bar et al.	23, 26 27	3 N. 3 N.	14 E. 14 E.	M. H. Manuel and Laura Manuel, Murphys	120	R. XIV, p. 116
Duryea	13, 24 25	5 N. 5 N.	11 E. 11 E.		130	R. VIII, p. 148;XIV, p. 117
Dutch Homestead	4, 9	3 N.	14 E.	Wm. H. Jenkins Estate, Murphys	63	
Eastland-Gray	31	5 N.	12 E.		84	R. XIV, p. 117
Eclipse	24, 25	5 N.	11 E.		39	R. XIII, p. 109; XIV, p. 117
Eighty-Three	21	4 N.	12 E.	Chas. Ratto Estate and Mary Joses, San Andreas	20	
El Encino				El Encino Cons. Blue Gravel Mng. Co. (a corp.), 148 Ronado Ave., c/o J. S. White, Piedmont		R. XII, p. 91; XIII, p. 103; XXI, p. 161
Ellen Vannan	25	5 N.	11 E.		40	Bull. 18, p. 124
El Oro Dredger						R. XXI, p. 162
Emery Group	8, 9 10, 11	4 N. 4 N.	13 E. 13 E.		510	R. XIV, pp. 117, 118; Bull. 18, pp. 124-125
Empire Gold & Empire Eight Dollar	25	2 N.	12E.	Lloyd L. Austin, Box 144, Copperopolis		

Ernestine	15	4 N.	10 E.	E. E. Bertagna and E. W. Davis, 1842 Clements St., San Francisco	10	
Eureka	25	6 N.	13 E.	Andrew Hereid, c/o Ray C. Parks, Central Bank Bldg., Oakland	20	
Fairview	28	3 N.	14 E.		60	R. XIV, p. 118
Fairview & I. X. L.	32	3 N.	14 E.	Balaklava Mng. Co., c/o Ray Nesbet, 501 Howard St., San Francisco	80	
Fine Gold	32	3 N.	14 E.	Edward Lundberg and Helen C. Anthes, c/o Mrs. Ruth Solari, Vallecito	40	
Finnegan	13	2 N.	13 E.	Ella Tarbat Taylor, 530 Bancroft Ave., San Leandro		
Forty-Nine	16, 17	3 N.	14 E.		37	R. XIV, p. 118
Fourth of July	34	5 N.	10 E.	Frank E. Pickard, Campo Seco		
Freccero	19, 20	4 N.	13 E.	B. and C. Freccero, San Andreas	100	
Gaston Hill & Cleveland	9, 10 32	4 N. 5 N.	13 E. 13 E.	R. L. Cuslidge, Mountain Ranch, et al.	80	R. XIV, p. 118
Glenn	31	5 N.	13 E.			R. XIX, p. 18; Pre. Rep. 8, p. 29
Gold Channel				Louis D. Sandoz, Mitchell Hill	20	
Gold Chief, No. 1, No. 2	18	6 N.	14 E.	Albert P. Myers, Rm. 800, 116 Temple St., Los Angeles	40	
Gold Hill	7	4 N.	10 E.	Calaveras Holding's Trustee, Ltd., Box 135, or 1071, 15th St., San Bernardino	160	
Good Oak	27	4 N.	12 E.	Louis B. Joses, San Andreas	20	
Gopher & Gopher No. 2	8	5 N.	12 E.	Catherine J. Vandel, Mokelumne Hill	39	
Grandy Flat	26	4 N.	12 E.	Marie Trenque et al., San Andreas	40	
Green Mountain et al.	18, 19 24	5 N. 5 N.	12 E. 11 E.		218	R. VIII, p. 148; XIII, pp. 107, 112; XIV, p. 118; XXI, p. 170; Bull. 18, p. 124
Grouch	20	4 N.	14 E.	Minnie J. Martin and Cora Shaw, Murphys	40	
Guerin	35	4 N.	13 E.	Leslie S. Edwards, 310 University Ave., Palo Alto	20	
Hangill	9	4 N.	11 E.	Jefferson R. Gillam, Valley Spring		
Hardscrabble	5	4 N.	11 E.	Sam E. Evans, Valley Springs	20	
Hatfield, Jr.	25	5 N.	11 E.	J. W. Hatfield, Jr., Mokelumne Hill	10	
Hartman	25	5 N.	11 E.		80	R. XIII, p. 108; XIV, p. 118
Hecla	28	3 N.	13 E.	George Lamb Estate, Angels Camp; John Lee et al., Altaville	20	
Hedrick	28	4 N.	12 E.		87	R. XIV, p. 118
Hexter Cons.	13, 23	5 N.	11 E.	Theodore Fershstand, Rm. 34, 704 Market St., or 45 Merced Ave., San Francisco	250	R. XIV, pp. 118-119; XXI, p. 170
Hidden Cave	10, 11	4 N.	13 E.	Louis Domenghini, Mountain Ranch	56	
Holiday	17	3 N.	14 E.	Douglas Flat Gold Mng. Co., c/o A. F. Kreye, Douglas Flat	27	
Hucks	24	2 N.	13 E.	Dr. H. Claude Huck et al., 558 Columbus Ave., San Francisco	3	
Hughes & Son, Deep Gravel et al.	23, 25	5 N.	11 E.	D. M. Riordan, 78 Mercedes Way, Ingleside Terrace	160	
Hutchinson						R. XIII, p. 109
Infernal						See Eclipse
Inspirational				F. H. Brown, 284 4th St., San Francisco		
Isabel Dredger						R. XIV, p. 126; XXI, p. 152; Bull. 57, p. 20

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* To save space, frequently only one of several names is shown in this column.

TABLE OF PLACER MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
I. X. L. Cons., Sunnyside & Gold Bar	12 7	5 N. 5 N.	13 E. 14 E.	Ruth Brewster, Edna McIntire et al., c/o E. C. Stewart, Box 485, Stockton	209	R. XIV, p. 119; XX, p. 6
Jack Rabbit	16, 17 20, 21	3 N. 3 N.	13 E. 13 E.	Purington Mining Co., Box 235, Angels Camp, et al.	120	R. XX, p. 7
Jens et al.	2	5 N.	12 E.	John C. Jens, Belmont	174	
Johnn Jumper	25	6 N.	13 E.		80	R. XIV, p. 119
Johnston	28	4 N.	12 E.	Desire J. Fricot, Angels Camp		
Johnson	22, 27	3 N.	13 E.	W. F. Johnson and Tillie Johnson, Altaville	40	
Jupiter						R. XIII, p. 109; Bull. 18, p. 125
Katherny Del Oro	2	5 N.	12 E.	C. M. Jacob, Apt. 1, 604 Irving St., San Francisco	20	
Kenross	11, 12	5 N.	12 E.		320	R. XIV, p. 88
Kentucky	23, 26	6 N.	13 E.	Thos. B. Bishop Co., 166 Geary St., San Francisco	118	
Kinney	27	3 N.	13 E.	W. F. Johnson et al., Altaville	26	
Kresge	23	4 N.	9 E.	Wayland Walker, Wallace	38	
La Capelle Flat	8	4 N.	13 E.	Chas. Shippy, San Andreas	30	
Last Chance	36	5 N.	11 E.		40	
Last Chance	2	4 N.	11 E.			
Last Chance Cons.	11 2	4 N. 5 N.	11 E. 11 E.	Louise E. Snyder, San Andreas	114	
Last Chance Gravel	13	4 N.	11 E.	Howard Copley and Irma Copley, Dorrington		
Last Hope	27	5 N.	11 E.	J. W. Hatfield, Jr., Mokelumne Hill, and J. D. Schrack Estate, Valley Springs	20	
Latimer Gulch	11	4 N.	11 E.	T. B. Jackson, San Andreas, and J. J. Hickey et al., c/o A. E. Gianelli, Stockton	80	
Lava Bed	25	6 N.	13 E.	A. J. Lester, Railroad Flat	80	
Lava Bed & Wallace	2, 3	5 N.	13 E.	R. E. L. Lampson et al., c/o O. Lampson, R.F.D. 1, Box 56, Folsom	170	
Lava Cap	2	3 N.	14 E.	Harold W. Herlihy, 1440 San Pasqual, Pasadena		
Lichan	28	3 N.	13 E.	John Lee et al., Altaville	12	
Line Stone & Mohawk	1, 11 12	4 N. 4 N.	13 E. 13 E.	Fort Mountain Mng. Corp., 1101 Central Bank Bldg., c/o J. W. O'Neill, Oakland, and Maude Kramer, 3906 Allendale St., Oakland, or Mountain Ranch	99	
Lipkey	6	4 N.	10 E.	Estate of Mrs. Barbara G. Crissey, c/o James D. Meredith, Merchants Nat'l Bank Bldg., Sacramento	29	
Lloyd	2, 11	4 N.	11 E.	Irving Smith, West Point or San Andreas, et al.	110	R. XIV, p. 119
Lombardi & Ellen Vannan	17 25	5 N. 5 N.	12 E. 11 E.	Louis J. Lombardi, Mokelumne Hill	60	Bull. 18, p. 124
Lone Star						R. XIII, p. 111
Long Gulch						R. XIII, p. 111
Lucky Boy				M. W. Hamby, Mokelumne Hill		

Lucky Tom						R. XIII, p. 111
Lundt & Drallmeyer	17	3 N.	13 E.	Purinton Mng. Co., and Frank R. Purinton, Box 235, Angels Camp	18	
Macchiavello						R. XIII, p. 111
Manitou	19	3 N.	14 E.		60	R. XIV, p. 119
Manzanita	20	3 N.	14 E.	John Valente, Douglas Flat	10	
Matthavale	34	5 N.	13 E.	Charles B. Coulter, Mountain Ranch	20	
Mary Ethel	15	4 N.	10 E.	Leslie L. Cook et al., P. O. Box 34, Vineburg	23	
Mead	25	5 N.	11 E.		40	R. XIV, p. 119
Meinecker & Sanguinette						R. XII, p. 89; XIII, p. 112; XX, p. 6
Merrimac, Fine Gold & Coarse Gold	10, 11	4 N.	11 E.	E. C. Schaefer, Emma Schaal et al., 1920 Mills Tower, 220 Bush St., San Francisco	100	
Meyer	21	3 N.	10 E.	Mary Meyer, c/o Nelson J. Meyer, Jenny Lind	7	
Missouri & Dolly Varden	17	3 N.	14 E.		35	R. XIV, p. 119
Mobile Bar	36	6 N.	12 E.	C. F. Kelton, Mokelumne Hill	40	
Monarch, Iron Monarch & Gertrude	11	4 N.	10 E.	Harriet E. Minahen, Lodi	49	
Mountain Pass	21	3 N.	14 E.	Antone Solari, Vallecito	10	
Mountain Ranch	5	4 N.	13 E.	Louis B. Jones, San Andreas	69	
Mountain Ranch	29, 32	5 N.	13 E.	Frank J. Winzell and Ada V. Winzell, Mountain Ranch	150	
Moyle						R. XII, p. 96; XIII, p. 114
Mutt	7	4 N.	14 E.		20	R. XIV, p. 119
McCann	24, 25	5 N.	11 E.		10	R. XIV, p. 119; XIX, p. 18
McCarty Group	19, 30	2 N.	12 E.	Jackson D. McCarty, Milton	371	
McSorley						See Green Mountain
Napoli	12	4 N.	9 E.	Gabriel Bitonti, Camanche	20	
New Century	16	3 N.	14 E.	Ed. P. Roberta, Douglas Flat	50	
New Schleswig	17, 18	5 N.	12 E.	W. H. Curnow et al., Mokelumne Hill	40	
Nigger Head	21	3 N.	13 E.	Louis E. Johnson and Mrs. M. M. E. Johnson, Box 966, Angels Camp	20	
Noce	11	5 N.	12 E.		320	R. XIV, p. 120; XIX, p. 18; XXI, pp. 157, 161; Pre. Rep. No. 8, p. 29
Norfolk						R. XII, p. 96; XIII, pp. 114-115
North Hill et al.	26, 27	3 N.	10 E.	Smile Pacheco, Jr., Jenny Lind	840	R. XIII, p. 99; XIV, p. 120
North Star	29	6 N.	14 E.	Clovis Laidet and Henry Sanguinetti, Railroad Flat		
North Star	21, 28	3 N.	13 E.	North Star Placer Mng. Co., c/o George B. Bennett, Angels Camp	80	R. XIV, p. 120
North Star	18, 19 25, 30	5 N. 5 N.	11 E. 12 E.		600	R. XIV, p. 120; Bull. 18, p. 124
O'Connell Blue Gravel	21	4 N.	12 E.		20	R. XIV, p. 120
Old McGregor & Old McGregor No. 2	13	4 N.	12 E.	Victor Lewis, San Andreas	30	
Old Stiff et al.	32	3 N.	14 E.	Security Title Insurance & Guarantee Co., Trustee, c/o M. Grant Hayden, Rowell Bldg., Fresno	161	R. XXI, p. 161
Old Timer	25	6 N.	13 E.	Henry W. Seeman, Railroad Flat	20	
Ophir	35	5 N.	11 E.	Elizabeth Beal, Valley Springs		
Ore Finea Diggings	28, 29	4 N.	13 E.	G. V. Veraguth and W. G. Wade, San Andreas	40	
Osborn & Gold Hill	32	3 N.	13 E.	Frank Reister, Sr., Angels Camp	31	
Oscar	10, 11 15	1 N. 1 N.	13 E. 13 E.	Stanislaus River Properties, c/o S. M. Levy, 71 Northampton Ave., Berkeley	120	
Ozark, Sewell & McGowan	23	3 N.	13 E.	Glendon L. Mitchler et al., Murphys	20	

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TABLE OF PLACER MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Paragon	23, 26	3 N.	13 E.		140	R. XIV, p. 120
Peachy	33	3 N.	13 E.	Grace L. Kuns, Box 1066, Angels Camp; Hobart Estate Co. and Emma Rose, 351 California St., San Francisco		
Peerless	15	4 N.	10 E.	Aniceto Arnos, Campo Seco		
Phillips						R. XII, p. 96
Plaza	32	5 N.	11 E.	Penn Mining Co., c/o Chas. R. Enos, Midland Saving Bank Bldg., Suite 719, Denver, Colorado	10	
Plug Ugly	21	4 N.	12 E.	J. A. Smith, San Andreas, Isaac Chapman and Mrs. Hattie J. D. Chapman, 1216 Leavenworth St., San Francisco	40	
Porteous Group				Mervin B. Porteous, Mokelumne Hill		R. XX, p. 76
Putman & Latimer Gulch	2, 11	4 N.	11 E.	J. J. Hickey, Cora Belle Lamb and Edna Gianelli, 120 N. San Joaquin St., c/o E. Gianelli, Stockton	150	R. XI, p. 177; XIII, p. 116
Railroad	35	4 N.	12 E.	Antone Costa and Louis Costa, San Andreas	49	
Railroad Hill	2	3 N.	12 E.	Louis De Martini, San Andreas	56	
Rainier					400	R. XIV, p. 120
Ratto	27	4 N.	12 E.	Virgil M. Airola, San Andreas	20	
Ravizza	34	4 N.	12 E.	Martha Byers, Box 65, San Andreas	39	
Reed Gravel	2, 11	4 N.	11 E.		157	R. XIV, p. 121
Reed & Shannon, Dashaway & Batten Bros.	16, 21 19, 20	3 N. 3 N.	14 E. 14 E.	Thomas B. Bishop Co., 166 Geary St., Whittle Bldg., San Francisco	349	
Reiner						See Victor
Reliable	31. 32	4 N.	11 E.	Rick and Mabel E. de Martini, Valley Spring	10	
Reo De Oro				Edward McClancey, Walter Pallercine and Dolie Colliers, West Point		
Reveal	4	4 N.	10 E.	Penn Mining Co., c/o Chas. R. Enos, Midland Saving Bank Bldg., Suite 719, Denver, Colorado	15	
Richie Hill	26	4 N.	12 E.	Louis Costa et al., c/o C. Cademartori, San Andreas	40	
Riley Boys	10	4 N.	13 E.	Irving C. Lewis and Phillips Frisbie Lewis, 306 14th St., Oakland	29	
Rising Star	2	4 N.	11 E.	Ancient River Corp., 516 Park Bldg., Worcester, Mass. Frank H. Robson, trustee, 156 5th Ave., New York	58	R. XIV, p. 121
Riverside et al.	24, 13 24	6 N. 5 N.	12 E. 12 E.	Calaveras Corp., R. R., Box 85, c/o Thos. Jacob, Visalia, California	280	
Roberts et al.	22	3 N.	10 E.	W. F. Sinclair, Jenny Lind	40	
Rojas & San Antone Creek				Jesus Lopez, Esmeralda	20	
Ronan	7	4 N.	11 E.	Mary E. Ronan, Box 18, Ione		

Rooney	25	5 N.	11 E.	Mrs. Mary Jane Rooney and Estate of Benj. Healy, 1775 N St., Washington, D. C.	160	R. XIV, p. 121
Rough Diamond	24	3 N.	13 E.	David R. Oard Estate and Geo. H. Bartelmie, Box 1087, Angels Camp	40	
Rough Diamond	24, 25	5 N.	11 E.	Justinian Caire, 573 Market St., San Francisco	44	R. XIV, p. 121
Round Butte	6	4 N.	14 E.	Martin P. Voinich, 4313 Essex St., Oakland	81	
Safe Deposit	25	5 N.	11 E.	Alice R. Snavely, 725 1st St., Woodland	39	
San Andreas						See Chapman
San Domingo & Rainbow	36	4 N.	13 E.	Domenich Dragone, Murphys, and Antone S. Ponte, Esmeralda	80	
San Justo						See Carson Creek
Schrack, L. M.	5	4 N.	11 E.	Sam E. Evans, Valley Springs	40	
Scott Hill	24 27	4 N. 4 N.	11 E. 12 E.	Rosa Cassinelli and Norma Cerruti, San Andreas	355	
Seeman	10	3 N.	12 E.	John A. Huberty, San Andreas	1	
Shaw Cons.	13, 24	5 N.	11 E.	Mrs. Mary Jane Rooney and H. M. Casey, Seattle, Wash.	20	
Shephard						See Big Bend
Simi	23	3 N.	13 E.	Mrs. Giovanni Val, 501 21st St., Richmond	20	
Snyder	6	3 N.	14 E.	Fred Schwoerer et al., Murphys, Annie Snyder Estate, c/o Chas. P. Snyder, San Andreas	65	
Solari	20	3 N.	14 E.	Mrs. Jessie Botto, Vallecito; Victor and Ruth Solari, P.O. Box 27, Vallecito; Mrs. Janie Tanner, 2854 Bryant St., San Francisco	5	
South Fork	30	4 N.	12 E.	Charles Preston and Kate Donovan, Box 171, San Andreas	20	
Spanish Bar Cons.	33	6 N.	12 E.	Carl J. Dell Orto, Mokelumne Hill	80	
Spring Gulch						R. XII, p. 97; XIII, p. 120
Square Head	21, 27	4 N.	12 E.		20	R. XIV, p. 122
Squires & Deep Shaft	2 25, 35	4 N. 5 N.	11 E. 11 E.		30	
Starve Out & Brogilio	28	3 N.	13 E.	Frank Broglio, Altaville	30	
Stockton Hill	12	5 N.	11 E.		13	R. XIV, p. 122
St. Patrick	11	4 N.	11 E.	John E. Jackson, San Andreas	10	
Stony Gulch						R. XIII, p. 121
Table Mountain	5	2 N.	14 E.		500	R. XIV, p. 122
Table Mountain Gravel et al.	1 11, 12 6, 7	4 N. 4 N. 4 N.	13 E. 13 E. 14 E.	California Trust Co., 629 S. Spring St., Los Angeles	434	
Table Mountain	10, 11 14, 15	4 N. 4 N.	13 E. 13 E.		2,500	R. XIV, p. 122
Table Rock						R. XIV, p. 122
Take What's Left						See Viola
Taylor	26	6 N.	13 E.	Lillie Taylor et al., Railroad Flat	136	
Tecumseh Chief	28	5 N.	13 E.	W. P. Bidwell et al., 2261 E. Market St., Stockton	80	
Texas	16, 17	3 N.	14 E.		19	R. XIV, p. 122
Treat						R. XIII, p. 121
Triangle	34	5 N.	11 E.	John J. McSorley, Mokelumne Hill	10	
Turkey Gulch	27	3 N.	10 E.	G. V. Ryland et al., 2329 E. Sonora St., Stockton; W. P. Merrill, 2025 E. Market St., Stockton	40	

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* To save space, frequently only one of several names is shown in this column.

TABLE OF PLACER MINES AND PROSPECTS, CALAVERAS COUNTY—Continued

Name of mine	Location			To whom assessed*	Area, acres	Bibliography
	Sec.	Twp.	Range			
Union Shaft	11	4 N.	11 E.		30	R. XIII, p. 121; XIV, p. 122
Upper Flat	14	5 N.	12 E.	Mrs. Celestina J. Guiffra, R.F.D., Box 72, Mokelumne Hill	10	
Uptograph						R. XII, p. 99; XIII, p. 121
Vandalia	1	4 N.	13 E.	John B. Ederer, Mountain Ranch	40	
Vandel	7	5 N.	12 E.	French Hill Gold Mines Co., (a corp.), c/o John I. Bolen, Pacific Southwest Bldg., Suite 207, Pasadena	35	
Victor	23, 26 27	3 N. 3 N.	13 E. 13 E.			R. XIV, p. 120; XIX, p. 18; XVIII, p. 99; XX, pp. 7; 178; XXI, p. 161
Vieth & Pellaton	18	5 N.	12 E.	Mrs. Annie R. Pellaton et al., 2043 Franklin St., Oakland	90	
Viola, Ohio & Garabaldi	8, 17	3 N.	14 E.	Chas. A. Peirano, Douglas Flat	69	R. XIV, p. 123
Vogelgesang	10	4 N.	11 E.	Sarash E. Gourley, 326 Broadway St., Santa Cruz, et al.	40	
Warren						See Glenn
Watson	25 31	5 N. 5 N.	12 E. 13 E.	Ed. Shopbill, Mountain Ranch	168	
West Lake et al.	25, 26	5 N.	11 E.	Calaveras Placer, Inc., 8343 Beverly Blvd., Los Angeles	27	R. XIV, p. 123
Whatcheer	24	5 N.	11 E.		140	R. XIV, p. 123
White Bros.	20	3 N.	14 E.	Wm. P. Mobley, Vallecito	69	
Wilkinson	15	1 N.	13 E.	Florence C. Henry, 4532 Drexel Blvd., Chicago, Illinois	50	
Williams						R. XIII, p. 123
Willow Creek	28	4 N.	12 E.	Effie E. Johnson, San Andreas	40	
Yale	8	5 N.	12 E.	Edmond Yale and Juline E. Yale, Mokelumne Hill	40	
Young Stiff	5	2 N.	14 E.	Robert P. Sloan, Vallecito	71	

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* To save space, frequently only one of several names is shown in this column.

SAN FRANCISCO FIELD DISTRICT

C. McK. LAIZURE, Mining Engineer

Reports covering the mines and mineral resources of all of the counties in the San Francisco field division are now available, and field work at present is confined to investigations for special reports upon various economic minerals.

LOS ANGELES FIELD DISTRICT

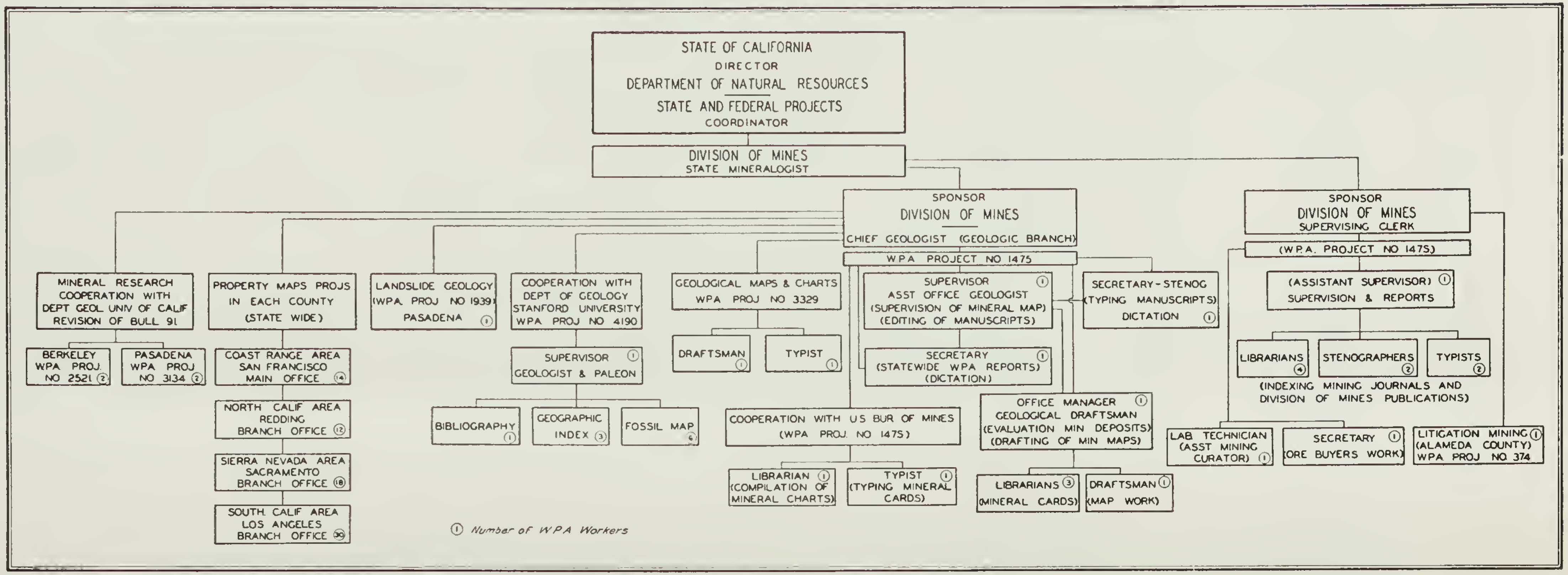
W. B. TUCKER and R. J. SAMPSON, Mining Engineers

Reports covering the mines and mineral resources of most of the counties in the Los Angeles field division are now available, and field work at present is confined to investigations for special reports upon Inyo and Mono counties.

GEOLOGIC BRANCH

CURRENT NOTES

OLAF P. JENKINS, Chief Geologist


STATE OF CALIFORNIA
DIRECTOR
DEPARTMENT OF NATURAL RESOURCES
STATE AND FEDERAL PROJECTS
COORDINATOR
DIVISION OF MINES
STATE MINERALOGIST
SPONSOR
DIVISION OF MINES
CHIEF GEOLOGIST (GEOLOGIC BRANCH)
WPA PROJECT NO 1475
SPONSOR
DIVISION OF MINES
SUPERVISING CLERK
(W.P.A. PROJECT NO 1475)
MINERAL RESEARCH COOPERATION WITH DEPT GEOL UNIV OF CALIF REVISION OF BULL 91
BERKELEY WPA PROJ. NO 2521 ②
PASADENA WPA PROJ NO 3134 ②
PROPERTY MAPS PROJS IN EACH COUNTY (STATE WIDE)
COAST RANGE AREA SAN FRANCISCO MAIN OFFICE ⑭
NORTH CALIF AREA REDDING BRANCH OFFICE ⑫
SIERRA NEVADA AREA SACRAMENTO BRANCH OFFICE ⑱
SOUTH CALIF AREA LOS ANGELES BRANCH OFFICE ㉚
LANDSLIDE GEOLOGY (WPA PROJ NO 1939) PASADENA ①
COOPERATION WITH DEPT OF GEOLOGY STANFORD UNIVERSITY WPA PROJ NO 4190
SUPERVISOR ① GEOLOGIST & PALEON
BIBLIOGRAPHY ①
GEOGRAPHIC INDEX ③
FOSSIL MAP ⑥
GEOLOGICAL MAPS & CHARTS WPA PROJ NO 3329
DRAFTSMAN ①
TYPIST ①
SUPERVISOR ① ASST OFFICE GEOLOGIST (SUPERVISION OF MINERAL MAP) (EDITING OF MANUSCRIPTS)
SECRETARY ① (STATEWIDE WPA REPORTS) (DICTATION)
COOPERATION WITH US BUR OF MINES (WPA PROJ. NO 1475)
LIBRARIAN ① (COMPILATION OF MINERAL CHARTS)
TYPIST ① (TYPING MINERAL CARDS)
SECRETARY-STENOG (TYPING MANUSCRIPTS) DICTATION ①
OFFICE MANAGER ① GEOLOGICAL DRAFTSMAN (EVALUATION MIN DEPOSITS) (DRAFTING OF MIN MAPS)
LIBRARIANS ③ (MINERAL CARDS)
DRAFTSMAN ① (MAP WORK)
(ASSISTANT SUPERVISOR) ① SUPERVISION & REPORTS
LIBRARIANS ④
STENOGRAPHERS ②
TYPISTS ②
(INDEXING MINING JOURNALS AND DIVISION OF MINES PUBLICATIONS)
LAB TECHNICIAN (ASST MINING CURATOR) ①
SECRETARY ① (ORE BUYERS WORK)
LITIGATION MINING ① (ALAMEDA COUNTY) WPA PROJ NO 374
① Number of WPA Workers

Organization chart showing in graphic form the extent to which the Division of Mines is making use of W. P. A. funds. A total of 114 W. P. A. workers are shown to be employed.

OIL FIELD DEVELOPMENT OPERATIONS

R. D. BUSH, State Oil and Gas Supervisor

From March 29, 1936, to and including June 27, 1936, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
COLUSA COUNTY:					
Birch Ranch and OilCo. and Irwin S. Burgess	6	14 N.	3 W.	Johnston 1	
FRESNO COUNTY:					
Kay Petroleum Corp.	6	20 S.	15 E.	8	Coalinga
Kolingo Drilling Co.	14	20 S.	14 E.	2	Coalinga
Mariel Oil Co.	26	20 S.	14 E.	3	Coalinga
Section Thirty Oil Co.	30	19 S.	15 E.	3	Coalinga
John F. Wilcox	11	20 S.	14 E.	4	Coalinga
Kettleman North Dome Assoc.	24	21 S.	16 E.	81	Kettleman North Dome
Kettleman North Dome Assoc.	24	21 S.	16 E.	83	Kettleman North Dome
Kettleman North Dome Assoc.	18	21 S.	17 E.	4	Kettleman North Dome
Kettleman North Dome Assoc.	28	21 S.	17 E.	58	Kettleman North Dome
Kettleman North Dome Assoc.	30	21 S.	17 E.	21	Kettleman North Dome
Kettleman North Dome Assoc.	30	21 S.	17 E.	43	Kettleman North Dome
Kettleman North Dome Assoc.	32	21 S.	17 E.	83	Kettleman North Dome
Kettleman North Dome Assoc.	34	21 S.	17 E.	21	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	25	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	32	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	56	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	61	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	65	Kettleman North Dome
Standard Oil Co.	36	21 S.	14 E.	South Coalinga 1	
Standard Oil Co.	31	21 S.	15 E.	Camino 1	
IMPERIAL COUNTY:					
CO-2 Production Co., Inc.	13	11 S.	13 E.	1	
CO-2 Production Co., Inc.	13	11 S.	13 E.	2	
KERN COUNTY:					
Buffalo Oil Co.	21	30 S.	29 E.	Buffalo-Jeppi 2	Edison
Buffalo Oil Co.	24	30 S.	29 E.	Buffalo-Wildman 1	Edison
R. E. Corbett	23	30 S.	29 E.	Rose 2	Edison
General Petroleum Corp.	10	30 S.	29 E.	Speed 10 8	Edison
General Petroleum Corp.	21	30 S.	29 E.	Magoffin 1	Edison
W. F. Higgins	17	30 S.	29 E.	Higgins 9	Edison
A. T. Jergins Trust	13	30 S.	29 E.	McCowan 13-A 6	Edison
A. T. Jergins Trust	14	30 S.	29 E.	Dougherty 6	Edison
A. T. Jergins Trust	23	30 S.	29 E.	R. R. Andrews 2	Edison
A. T. Jergins Trust	23	30 S.	29 E.	Jergins-Texas Fee 23 1	Edison
A. T. Jergins Trust	23	30 S.	29 E.	Jergins-Texas Fee 23 8	Edison
A. T. Jergins Trust	23	30 S.	29 E.	Jergins-Texas Fee 23 29A	Edison
M. & L. Oil Co.	23	30 S.	29 E.	Santa Clara 2	Edison
R. & R. Development Co.	32	30 S.	30 E.	R. & R. 2	Edison
R. & R. Development Co.	32	30 S.	30 E.	R. & R. 3	Edison
Treasure Drilling Co., Ltd.	12	30 S.	28 E.	Treasure 1	Edison
Union Oil Co.	14	30 S.	29 E.	Reese 1	Edison
Wood-Callahan Oil Co., Ltd.	21	30 S.	29 E.	Needham 1	Edison
Wood-Callahan Oil Co., Ltd.	23	30 S.	29 E.	Gerard 1	Edison
Elk Hills Petroleum Corp.	14	31 S.	24 E.	1	Elk Hills
T. E. Connolly	21	29 S.	27 E.	Borton 1	Fruitvale
Dixie Lee Oil Co.	23	29 S.	27 E.	4	Fruitvale
H. L. J. Oil Co.	23	29 S.	27 E.	H. L. J. 1	Fruitvale
Magnet Oil Co.	21	29 S.	27 E.	Seymour 3	Fruitvale
Mohawk Petroleum Co.	23	29 S.	27 E.	K. C. L. 23 1	Fruitvale
Mohawk Petroleum Co.	26	29 S.	27 E.	Bowman 1	Fruitvale
Mosebach Oil Co.	21	29 S.	27 E.	Mosebach 1	Fruitvale
Nydia Petroleum Co.	26	29 S.	27 E.	Ticehurst 1	Fruitvale
Trico Oil and Gas Co.	23	29 S.	27 E.	Knowles 1	Fruitvale
Western Gulf Oil Co.	22	29 S.	27 E.	22-KCL-B	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Parker 4	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Red Ribbon Ranch 3	Fruitvale
Associated Oil Co.	23	28 S.	27 E.	51	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	57	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	59	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	60	Kern River
C. C. M O. Co.	23	28 S.	27 E.	61	Kern River
V. W. David Oil Co.	8	29 S.	28 E.	Pierce 8	Kern River

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued:					
Elbee Petroleum Co.	13	28 S.	27 E.	1	Kern River
General Petroleum Corp.	14	28 S.	27 E.	Young 43	Kern River
General Petroleum Corp.	14	28 S.	27 E.	Young 48	Kern River
National Oil Co.	1	28 S.	27 E.	Pacific 1	Kern River
National Oil Co.	11	28 S.	27 E.	Provident 4	Kern River
National Oil Co.	11	28 S.	27 E.	Universal 2	Kern River
Pacific Oil and Gas Development Corp.	1	28 S.	27 E.	Pacific 2	Kern River
Republic Petroleum Co.	11	28 S.	27 E.	Fleishacker 2	Kern River
Republic Petroleum Co.	11	28 S.	27 E.	Fleishacker 3	Kern River
Republic Petroleum Co.	12	28 S.	27 E.	Crosby 1	Kern River
Republic Petroleum Co.	24	28 S.	27 E.	Strassburger 8	Kern River
Republic Petroleum Co.	24	28 S.	27 E.	Straaburger 10	Kern River
Seven Spot Oil Co., Inc.	13	28 S.	27 E.	1	Kern River
Standard Oil Co.	15	28 S.	27 E.	26	Kern River
The Texas Co.	23	28 S.	27 E.	Lehmann 12	Kern River
Union Oil Co.	11	28 S.	27 E.	Del Rey 8	Kern River
Vega Oil Co.	11	28 S.	27 E.	Vega 2	Kern River
East Puente Oil Co.	11	30 S.	21 E.	Home Lease 21	McKittrick
East Puente Oil Co.	11	30 S.	21 E.	Home Lease 22	McKittrick
Welport Oil Co.	26	29 S.	21 E.	14	McKittrick
Welport Oil Co.	26	29 S.	21 E.	15	McKittrick
John A. Alford	4	32 S.	23 E.	Alford B-1	Midway
Burkholder Oil Corp.	23	32 S.	23 E.	Orloff 1	Midway
Hugh B. Evans, Inc.	35	32 S.	23 E.	11	Midway
Hugh B. Evans, Inc.	35	32 S.	23 E.	16	Midway
Garner Royalties Co., Ltd.	22	32 S.	23 E.	Garner 1	Midway
North American Oil Consolidated	2	32 S.	24 E.	2	Midway
Quality Oil Co.	22	32 S.	23 E.	Cypress 2	Midway
South Cerritos Oil Co.	22	32 S.	23 E.	1	Midway
Standard Oil Co.	33	32 S.	24 E.	54	Midway
Standard Oil Co.	33	32 S.	24 E.	55	Midway
R. A. Stimson Oil Co.	27	32 S.	23 E.	Stimson 1	Midway
The Texas Co.	32	32 S.	24 E.	15	Midway
Bourke & Dyer	28	26 S.	28 E.	Stockton 1	Mt. Poso
General Petroleum Corp.	16	27 S.	28 E.	Heisen 13	Mt. Poso
General Petroleum Corp.	16	27 S.	28 E.	Heisen 30	Mt. Poso
General Petroleum Corp.	16	27 S.	28 E.	Heisen 33	Mt. Poso
E. J. Harp and Geo. L. Tilton	6	27 S.	28 E.	Harp-Tilton 1	Mt. Poso
R. S. Lytle	26	27 S.	28 E.	Dorsey 3	Mt. Poso
McAdams Oil Co.	32	26 S.	28 E.	Bellport 1	Mt. Poso
Union Oil Co.	28	27 S.	28 E.	Trive 11	Mt. Poso
Union Oil Co.	34	27 S.	28 E.	Murdoch 1	Mt. Poso
Allied Petroleum Corp.	19	30 S.	29 E.	Allied 19	Mountain View
Buffalo Oil Co.	19	30 S.	29 E.	Buffalo 3	Mountain View
Fullerton Oil Co.	18	30 S.	29 E.	Bloemer 1	Mountain View
The Hancock Oil Co.	14	30 S.	28 E.	Miller 10	Mountain View
Hogan Petroleum Co.	32	30 S.	29 E.	Foster Comm. 4	Mountain View
Hogan Petroleum Co.	4	31 S.	29 E.	Symons-C. C. M. O. 3	Mountain View
A. T. Jergins Trust	19	30 S.	29 E.	Blackburn 2	Mountain View
The Petrol Corp.	32	30 S.	29 E.	Porter 1	Mountain View
Standard Oil Co.	13	30 S.	28 E.	Calif. Lands Inc. 1	Mountain View
Standard Oil Co.	18	30 S.	29 E.	Mabry 1	Mountain View
Vesta Petroleum Co., Ltd.	19	30 S.	29 E.	Hopkins 10	Mountain View
Bargol Oil Co., Ltd.	11	27 S.	27 E.	Bargol 1	Poso Creek
The Ohio Oil Co.	32	27 S.	27 E.	Midway Premier 11	Poso Creek
The Ohio Oil Co.	32	27 S.	27 E.	Midway Premier 12	Poso Creek
Standard Oil Co.	5	28 S.	27 E.	11	Poso Creek
Standard Oil Co.	9	28 S.	27 E.	1	Poso Creek
Union Oil Co.	8	27 S.	27 E.	Ford 1	Poso Creek
Barnsdall Oil Co.	7	28 S.	29 E.	Caldwell 5	Round Mountain
Barnsdall Oil Co.	7	28 S.	29 E.	Caldwell 6	Round Mountain
Benito-Huntington Oil Co., Inc.	8	28 S.	29 E.	Benito-Huntington Staley 1	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	2	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	34	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	45	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	56	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	67	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	77	Round Mountain
Honolulu Oil Corp., Ltd.	20	28 S.	29 E.	1	Round Mountain
Honolulu Oil Corp., Ltd.	20	28 S.	29 E.	11	Round Mountain
Petroleum Securities Co.	6	28 S.	29 E.	Coffee 5	Round Mountain
Piute Holding Co.	17	28 S.	29 E.	Piute 1	Round Mountain
Shell Oil Co.	7	28 S.	29 E.	Caldwell 4	Round Mountain
Shell Oil Co.	7	28 S.	29 E.	Caldwell 5	Round Mountain
Shell Oil Co.	7	28 S.	29 E.	Caldwell 6	Round Mountain
Shell Oil Co.	7	28 S.	29 E.	Caldwell 7	Round Mountain
Shell Oil Co.	7	28 S.	29 E.	Caldwell 8	Round Mountain

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued:					
Shell Oil Co.	7	28 S.	29 E.	Caldwell 9	Round Mountain
Shell Oil Co.	7	28 S.	29 E.	Caldwell 11	Round Mountain
Shell Oil Co.	7	28 S.	29 E.	Caldwell 12	Round Mountain
Shell Oil Co.	7	28 S.	29 E.	Caldwell 13	Round Mountain
Shell Oil Co.	7	28 S.	29 E.	Caldwell 14	Round Mountain
Shell Oil Co.	20	28 S.	29 E.	Freeman 10	Round Mountain
Berry Holding Co.	34	12 N.	24 W.	Hillside 23	Sunset
Chief Oil Co.	6	11 N.	23 W.	Francis 3	Sunset
General Petroleum Corp.	6	11 N.	23 W.	15–B	Sunset
General Petroleum Corp.	6	11 N.	23 W.	Main Line 2	Sunset
General Petroleum Corp.	35	12 N.	24 W.	Moco 35–335	Sunset
Gibson Oil Co., Inc.	6	11 N.	23 W.	Francis 2	Sunset
Gibson Oil Co., Inc.	6	11 N.	23 W.	O'Brien 2	Sunset
Gibson Oil Co., Inc.	6	11 N.	23 W.	O'Brien 3	Sunset
Gibson Oil Co., Inc.	8	11 N.	23 W.	West Side Lumber Co. 1	Sunset
Otis Hoyt	7	11 N.	23 W.	Otis Hoyt Maricopa 1	Sunset
Obispo Oil Co.	32	12 N.	23 W.	12	Sunset
Shell Oil Co.	7	11 N.	23 W.	Dorsey-Flack 1	Sunset
Signal Oil and Gas Co.	8	11 N.	23 W.	Sheehan 6	Sunset
Standard Oil Co.	5	11 N.	23 W.	4	Sunset
Standard Oil Co.	5	11 N.	23 W.	9	Sunset
Standard Oil Co.	5	11 N.	23 W.	203	Sunset
Standard Oil Co.	31	12 N.	23 W.	30	Sunset
E. A. Bender	14	10 N.	23 W.	Robinson 1	
Cochran Oil Co., Inc.	31	25 S.	27 E.	Bishop 1	
Modoc Petroleum, Ltd.	21	26 S.	28 E.	Modoc-Vedder-Bowles 2	
Mohawk Petroleum Co.	10	31 S.	29 E.	Earl Fruit Co. 1	
The Ohio Oil Co.	36	11 N.	19 W.	Title Insurance & Trust 1	
The Ohio Oil Co.	5	32 S.	26 E.	K. C. L. A–7	
Pioneer Holding Co.	17	30 S.	30 E.	Pioneer 2	
Reserve Oil and Gas Co.	33	11 N.	19 W.	33–2	
Rio Grande Oil Co.	18	28 S.	20 E.	Layman 1	
Santa Carla Oil Co.	19	26 S.	28 E.	Bass & Goodknight 1	
Signal Oil and Gas Co.	30	32 S.	30 E.	Tejon 1	
KINGS COUNTY:					
Kettleman North Dome Assoc.	2	22 S.	17 E.	51	Kettleman North Dome
Standard Oil Co.	35	21 S.	17 E.	48	Kettleman North Dome
Associated Oil Co.	35	23 S.	17 E.	Avenal 1	
LOS ANGELES COUNTY:					
Shell Oil Co.	33	3 S.	13 W.	Reyes 84	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 81	Dominguez
Shell Oil Co.	34	3 S.	13 W.	Reyes 85	Dominguez
Union Oil Co.	28	3 S.	13 W.	Callender 47	Dominguez
Union Oil Co.	33	3 S.	13 W.	Hellman 43	Dominguez
Kettleman & Inglewood Corp.	8	2 S.	14 W.	Cone 19	Inglewood
Shell Oil Co.	8	2 S.	14 W.	Rindge 20	Inglewood
Shell Oil Co.	8	2 S.	14 W.	Rindge 22	Inglewood
Silver Petroleum Co.	16	2 S.	14 W.	Baldwin Hills 1	Inglewood
Standard Oil Co.	8	2 S.	14 W.	L. A. Investment Lease 78	Inglewood
Big 4 Oil Co.	19	4 S.	12 W.	3	Long Beach
Italo Petroleum Corp.	19	4 S.	12 W.	Italo 6	Long Beach
Italo Petroleum Corp.	19	4 S.	12 W.	Italo 7	Long Beach
Oceanic Oil Co.	29	4 S.	12 W.	Oceanic 5	Long Beach
Richfield Oil Co.	5	2 S.	11 W.	Pasadena 1	Montebello
Standard Oil Co.	1	2 S.	12 W.	Baldwin 85	Montebello
Standard Oil Co.	1	2 S.	12 W.	Baldwin 86	Montebello
Universal Consolidated Oil Co.	5	2 S.	11 W.	B. C. 1	Montebello
Universal Consolidated Oil Co.	6	2 S.	11 W.	P 2	Montebello
Universal Consolidated Oil Co. and Richfield Oil Co.	6	2 S.	11 W.	Nutt 1–J	Montebello
Del Rey Drilling Co.	27	2 S.	15 W.	Del Rey 27–1	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	Del Rey 14	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	King Vidor 16	Playa del Rey
Republic Petroleum Co.	18	3 S.	13 W.	Republic Trust 1	Rosecrans
General Petroleum Corp.	5	3 S.	11 W.	Santa Fe 46–D	Santa Fe Springs
Union Oil Co.	31	2 S.	11 W.	Howard 17	Santa Fe Springs
Union Oil Co.	5	3 S.	11 W.	Farwell 21	Santa Fe Springs
Continental Oil Co.	11	5 S.	12 W.	Bixby 39	Seal Beach
Russell A. Brown	31	3 S.	14 W.	1	Torrance
Continental Royalties, Ltd.	6	4 S.	14 W.	Continental Royalties 1	Torrance
Dumas-Brown Oil Co.	6	4 S.	14 W.	Dumas-Brown 1	Torrance
Dumas-Lewis Oil Co.	6	4 S.	14 W.	Dumas-Lewis 2	Torrance

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Continued:					
Lawler Petroleum Co.	6	4 S.	14 W.	1	Torrance
Lawler Petroleum Co. No. 2	31	3 S.	14 W.	2	Torrance
Geo. K. Linderman Oil Corp.	31	3 S.	14 W.	1	Torrance
Geo. K. Linderman Oil Corp.	31	3 S.	14 W.	2	Torrance
Macvan Oil Co.	31	3 S.	14 W.	1	Torrance
Pongratz Petroleum Co.	6	4 S.	14 W.	1	Torrance
Redondo Oil Co.	31	3 S.	14 W.	Security 1	Torrance
Regent Oil Co.	6	4 S.	14 W.	Regent 1	Torrance
Rennek Oil & Gas Corp.	5	4 S.	14 W.	2	Torrance
W. C. Roach	31	3 S.	14 W.	1	Torrance
W. C. Roach	6	4 S.	14 W.	W. C. Roach 2	Torrance
C. R. Schuster	31	3 S.	14 W.	C. R. S. 1	Torrance
Shell Oil Co.	33	3 S.	14 W.	Lloyd-Dabney 1	Torrance
Sterling Oil Co.	31	3 S.	14 W.	Sterling 2	Torrance
The Texas Co.	5	4 S.	14 W.	Redondo Imp. Co. 6	Torrance
Tu Jax Oil Co.	32	3 S.	14 W.	Tu Jax 2	Torrance
Walken Oil Co.	5	4 S.	14 W.	1	Torrance
Codri Oil Co.	29	4 S.	13 W.	Codri 1	
Crude Oil Drilling Co., Ltd.	31	3 S.	13 W.	Crude Oil Gardena 1	
General Petroleum Corp.	4	5 S.	13 W.	Terminal 1	
James S. Hull	20	4 S.	13 W.	Hull 2	
McVicar-Rood	6	2 S.	9 W.	Sentous 1	
The Ohio Oil Co.	7	3 S.	14 W.	Gough 1	
MADERA COUNTY:					
The Pure Oil Co.	17	10 S.	14 E.	Chowchilla 3	
The Pure Oil Co.	20	10 S.	14 E.	Chowchilla 4	
MERCED COUNTY:					
E. R. Fantz, Attorney-in-Fact	22	7 S.	16 E.	Cunningham 1	
ORANGE COUNTY:					
DeAugustine, Abrams & Daly Oil Co.	20	3 S.	9 W.	Barnett 1	Coyote Hills
West American Oil Co.	24	3 S.	10 W.	W. A. 13	Coyote Hills
The Texas Co.	35	5 S.	11 W.	Towers 6	Huntington Beach
Union Oil Co.	29	3 S.	9 W.	Chapman 22	Richfield
Union Oil Co.	29	3 S.	9 W.	Chapman 30	Richfield
Union Oil Co.	29	3 S.	9 W.	Chapman 31	Richfield
Union Oil Co.	29	3 S.	9 W.	Chapman 32	Richfield
B. A. L. Oil Co.	36	5 S.	11 W.	B. A. L. 1	
Five Points Petroleum Corp.	36	5 S.	11 W.	Shuhs 1	
Shell Oil Co.	7	6 S.	10 W.	Anaheim 3–1	
George Terry	17	5 S.	11 W.	Westminster Gun Club 1	
RIVERSIDE COUNTY:					
J. F. Kosanke	15	2 S.	6 W.	1	
SAN BERNARDINO COUNTY:					
E. F. Stella, Trustee	32	2 S.	8 W.	Stella-Grant 1	
E. F. Stella, Trustee	33	2 S.	8 W.	Kraemer-Backs 2	
E. F. Stella, Trustee	4	3 S.	8 W.	Pellissier 1	
SAN JOAQUIN COUNTY:					
Holly Development Co.	16	2 S.	5 E.	Paddon 1	
Standard Oil Co.	25	2 N.	4 E.	Weyl-Zuckerman 1	
SAN LUIS OBISPO COUNTY:					
Crail Bros. Inc., Ltd.	8	32 S.	13 E.	Vetter 1	Arroyo Grande
A. T. Jergins Trust	5	32 S.	13 E.	Lowther 1	Arroyo Grande
Avila Oil Co.	10	32 S.	13 E.	Gibson 1	
E. D. Bacon	22	31 S.	21 E.	Munsey 1	
Barnsdall Oil Co.	24	28 S.	17 E.	Wreden 1	
SANTA BARBARA COUNTY:					
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 1–10	Capitan
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 1–13	Capitan
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 1–14	Capitan
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 1–15	Capitan
Shell Oil Co.	32	5 N.	30 W.	Cavarrubias 1–17	Capitan
York Oil Co.	33	8 N.	34 W.	A–2	Lompoc
R. R. Bush Oil Co.	13	10 N.	34 W.	Hancock-Bush, Enos 1	
Tony Cornero	17	4 N.	25 W.	Fithian 1	
La Canada Oil Corp.	35	5 N.	30 W.	Rhode Island Estates 1	
Top Row Oil Co.		6 N.	35 W.	Spanne 1	
Union Oil Co.	24	10 N.	34 W.	Battles 1	

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
SOLANO COUNTY:					
Amerada Petroleum Corp.	26	4 N.	2 E.	Emigh 1	
SUTTER COUNTY:					
The Buttes Oilfields, Inc.	18	15 N.	2 E.	Buttes (Annex) 4	
Chance Development Co.	6	15 N.	1 E.	Fick 1	
TULARE COUNTY:					
W. H. Fortine	22	22 S.	26 E.	Mosesian 1	
VENTURA COUNTY:					
Bestco Petroleum Corp.	2	3 N.	19 W.	Frey 1	Bardsdale
The Texas Co.	4	3 N.	19 W.	Shiells 130	Bardsdale
The Texas Co.	4	3 N.	19 W.	Shiells 131	Bardsdale
Bolsa Chica Oil Corp.	4	4 N.	18 W.	Snow 4	Piru
C. C. M. O. Co.	15	3 N.	24 W.	Hobson A-4	Rincon
Continental Oil Co.	24	3 N.	24 W.	Grubb 5	Rincon
Calkan Petroleum Corp.	23	5 N.	20 W.	1	Sespe
Speik Oil Co.	33	5 N.	19 W.	1	Sespe
Honolulu Oil Corp., Ltd.	23	3 N.	21 W.	Hobson 1	South Mountain
Associated Oil Co.	27	3 N.	23 W.	Lloyd 23	Ventura
Shell Oil Co.	29	3 N.	23 W.	Taylor 87	Ventura

SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of California Journal of Mines and Geology.

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of the new laws and official regulations and notices affecting the mineral industry.

PLACER MINING IN CALIFORNIA WITH POWER SHOVELS

By C. A. Logan[1]

Introduction.

When the financial depression finally reached California with full force in 1932, many contractors who had been employed on highway construction, excavations for buildings, dams and other forms of earth-moving operations, were left unemployed with sometimes large inventories of equipment idle on their hands. These men argued that they should be able to make a success of surface placer mining for gold, which they pictured as a simple job of digging, transporting and washing sand and gravel. The more enterprising among them began operations with little preliminary prospecting or investigation, with the result that many of them failed. Their work, however, and the increased gold price, attracted the attention of more experienced and careful men who evolved a method of shallow placer mining which is proving successful under proper conditions. The essential items of equipment for this work are a mobile drag-line for excavation and a floating barge carrying the washing plant. Such an outfit is locally known as a 'doodle-bug' dredge.

Areas adapted to small-scale mechanical placer mining.

In a general way, mining engineers and placer operators have long known of scattered parcels of land carrying gold in too small quantity for profitable mining by hand, but where the yardage of available gravel was too small to justify a bucket dredge, and where conditions did not permit hydraulic mining. Such deposits may be successfully worked by mechanical shovels or drag-line under certain favorable conditions, the most important of which are: (1) Shallow uncemented gravel without too many large boulders, (2) soft bedrock, (3) gold content from 2 to 4 times greater than would be required for a bucket dredger, (4) water supply, (5) sufficient yardage. These areas of land are found principally along the rivers or small streams in the lower foothills on the east side of Sacramento and San Joaquin valleys, and also in some of the other gold mining counties. Geologically, the deposits may be creek or river gravel, or ancient shore-line deposits dissected and reconcentrated by modern streams.

Types of equipment used.

A great variety of earth-moving equipment has been tried, with mixed success, in exploiting these deposits. The mobile drag-line with floating washing plant has been most successful. Stationary drag-lines, steam or gasoline shovels with trucks to transport gravel to a stationary washing plant, and tractor-operated scrapers ("bulldozers") have been used. Some people of visionary and inventive minds have worked out expensive and usually impractical outfits which generally have a short life.

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[1] District Mining Engineer, Sacramento.

Drag-line dredges.

Stationary and mobile drag-line outfits have been used extensively for years to dig and load sand and gravel and their characteristics are well known. Their use in gold placer mining, however, introduces some undesirable factors such as (1) intermittent supply of feed to the washing plant, (2) constant churning up of the gravel being dug with gold settling to the bottom and a muddy water supply, (3) lost time for moves, servicing and repairs. The low initial cost permits amortization of plant to be realized on a few acres of good gravel. The entire plant can be easily and quickly moved. It is doubtful, if in skilled hands, the loss of gold is much greater than with standard dredgers, though it is certain that some operators have not made a good saving of gold. The yardage handled even by one of these outfits is too large to make it likely that special machines or processes can be used to save the fine, flaky or rusty gold that is lost. Improvement must come therefore in the riffles used as standard equipment, and experimentation to determine the proper grades for sluices, the water supply, most suitable sluice area, mercury traps and proper screening.

Wyandotte Gold Dredging Company. This company, which started work on Wyandotte Creek, southeast of Oroville in December, 1933, was composed of men who had technical training and practical experience in mining as well as in the use of excavating machinery, and have been more consistently successful with their numerous drag-line ventures than any other outfit in the business. This success has been due not only to hard work, but to careful prospecting of the ground, close attention to gold-saving equipment and operating details and costs. They have installed and operated several plants in Butte and have also operated in Placer and Shasta counties. They justly place a cash value on the detailed specifications of the equipment which they have found most suitable for the work, and have been reluctant to have full details published, but the main items may be described.

The work on Wyandotte Creek has been done on a typical deposit of loose, fine to medium-sized creek gravel, on a soft bedrock of clay or decomposed 'porphyry.' Prospecting was done by sinking shafts about 4 ft. by 6 ft. in cross section, and washing the gravel twice in a rocker. Part of the ground was covered with soil and sand overburden, which is easily moved off by the drag-line if found to not be worth washing. Two plants were in operation when visited. The older one was using a P. & H. 600-A Excavator, operated by a 115 h. p. Buda Diesel engine. It had a 40-ft. boom and used a 1¼ cu. yd. bucket. The wooden barge carrying the washing plant was 30 ft. by 40 ft. The welded steel plate hopper receiving gravel was 10 ft. by 11 ft. with a grizzly of 90-lb. rails spaced 12 inches (16 inch centers). The trommel is of link belt make, 54 inches by 24 ft. with three-eighths in. holes in the screening section. This company has experimented considerably with screens. Close spacing of holes was found to result in overloading the head sluices. When the spacing between holes was increased to 1 inch and 1¼ inches, center to center, and all holes staggered, the life of the screen was increased and distribution of pulp was better. Riffles were carried in eight sluices 24 inches by 12 ft. and in 40 feet of sluice 40 inches wide on each side. Riffles were made up from 1-inch lumber dressed to about ¾-inch thick, 1¼ inches deep and spaced 1¼ inches apart, on a grade of 1¼ to 1½ inches per ft. Mercury traps 8 inches wide were placed in each of the 4 upper boxes. Upper edges of riffles were covered with barrel hoop iron 1 inch wide.

Power for pumping water and operating the screen and stacker was furnished by a No. 50 Caterpillar Diesel engine, rated at 62 h.p. Sixty miner's inches of water was purchased, and was supplied to the trommel and hopper by a centrifugal pump with 7-in. discharge. The proportion of sand to water, or water duty, varied on account of the unequal distribution of pulp through the screen to the various sluices, and also with the composition of the ground being worked. The average fine tailing is probably 10% to 15% of sand as discharged from the side sluices, unless especially sandy ground is being worked.

This outfit handled about 128 cu. yd. an hour, and had under favorable conditions an average running time of 17½ hours or better out of 24, giving a total up to 2200 cu. yd. daily. From 5 to 8 minutes was required for making a move. In soft ground timber mats are used under the drag-line treads, and more time is required. If an average of 16 hours of actual digging is maintained out of 24, it is creditable.

Different operators have their favorite engines and make special claims for them. In this case, remarkably low fuel costs had been achieved, using Diesel oil. The operators reported the two engines were using only about $5.25 worth of fuel daily. The cost of lubrication would bring the total to scarcely $7 a day.

Lights are furnished by Kohler lighting plants.

Buckets also have been the subject of much experimentation, here and elsewhere. Each type of several tried was found to have certain advantages and limitations. Page standard and heavy duty buckets seem to have been favored in many localities. A set of manganese steel bucket teeth is dulled each shift. They are built up by the welder and give 3 or 4 months service with ordinary wear.

Fine tailing discharges from the side sluices several feet behind the barge. The belt conveyor for coarse material was 35 ft. long, 2 ft. wide and traveled about 200 ft. per minute.

With this plant, the company has reported operating costs reduced from 16 cents a cu. yd. at the start, to 10 cents after 18 months' experience. A still further reduction was anticipated, and is believed to have been realized, with new outfits put in operation since then. The older plant is representative of many in use the past two years in California.

Cost of drag-line dredging outfits.

As mentioned elsewhere, contractors with idle excavating equipment were among the first to start drag-line dredging. If they did not own the drag-line outfit, which was the most expensive plant item, they could usually buy more advantageously than the average company. Therefore, many of the earlier outfits, using second-hand digging equipment and engines, and washing plants with light, cheap screens and hoppers, were assembled and put in operation at total costs claimed to vary from $12,000 to $20,000, of which a large part was often not a new capital outlay, but in the shape of equipment of which the original cost had perhaps long since been recovered by profits of operation on other jobs.

When outside companies came into the business with new machinery of standard grades, the capital outlay has been found to run around $40,000 by the time digging started.

The principal items of this outlay were:

Approximate Cost New of Principal Items, Drag-line Dredges

Drag-line ($1\frac{1}{4}$ to $1\frac{3}{4}$ cu. yd. bucket, 50-ft. boom)	$14,000–$16,500
Spare bucket	1,000– 1,200
Diesel engine power for drag-line	3,700– 5,000
Washing plant complete, including wooden barge 30 ft. x 40 ft., standard weight hopper, trommel, pump, engine, etc.	12,000– 14,000
Shop, auto truck, welding outfit, etc.	3,000– 3,500
Composite total derived from several cases	$33,700–$40,200

Although the drag-line can be used to remove overburden, in some cases operators may prefer to use tractors or 'bulldozers.' The above costs assume that water is delivered to the dredge by gravity. If a well and/or a pumping plant are required, an additional sum of $2,000 to $3,000 must be added.

The life of some of the units is limited and a monthly charge should be allowed of from $1,000 to $1,500 for maintenance, repairs and replacements.

If water supply has to be purchased, as is usually the case, this may cost as much as $175 a month.

From 10 to 14 men are employed on one of these outfits, and there is quite a variation in labor costs between a case like Wyandotte Dredging Company when one or more of the partners works long hours, and a stock company with a paid superintendent or manager who does little or no actual labor. The labor item may therefore vary from $1,800 to $2,800 a month, including compensation insurance, but not the wages of a special Diesel engine mechanic whose time may be divided among several plants in some districts.

Total operating and maintenance costs may therefore vary from $3,500 to $5,500 a month. The equipment and operating routine for this class of work have not been standardized to the point where it is possible to make many definite statements as to total operating cost per cubic yard. This cost is dependent on the type and quality of equipment, the ability and experience of those in charge, and the character of the ground being worked. There are great variations in all these elements. Operating costs reported to the writer have varied from $4\frac{1}{4}$ cents to 25 cents per cubic yard in place. The lowest cost, equal to that applying to the largest bucket dredge operations, is not at all representative. It is claimed to have been achieved on a deposit of very loose gravel covered with loam where a capacity of 225 yards in place per operating hour was reached, working in ground 8 to 12 ft. deep, and operating 18 hours out of 24. The other extreme, 25 cents a yard, was reported by one of the earlier installations on a dissected shore-line deposit, where the 'pay-streak' was difficult to follow and the operators were learning the business. Generally speaking, operators who have been successful on what may be called average ground have been lowering their costs as they gained experience, reducing the figure from 16 cents to 8 cents a cubic yard.

How much should be added to these figures to arrive at total cost for any particular operator will depend on the useful life of his plant, and cost of land or royalty paid. Few concerns have enough ground in reserve to realize the full life of their major equipment. Some of these outfits have already passed through several hands. They can be dismantled and moved readily about the state with small loss of time. Obtaining figures for amortization in such cases is difficult. If an operator has been fortunate enough to obtain in one holding 2,000,000 cu. yd. of gravel that will pay to work it would be unusual. A minimum of 1,000,000 cu. yd. is desirable to warrant starting operation.

The above discussion has been based on the use of Diesel engines for power. In some cases, where electric power transmission lines are near the site of proposed operations, electricity may be used with less first cost for power equipment and, it is claimed, less lost time. One outfit near Lincoln uses electricity to run the washing plant, and one in Calaveras County uses electric power throughout.

The other differences between the various plants are principally in the size of the barge carrying the washing plant and its draught, varying with area and load; and in the length of booms and types of bucket on the drag-lines. A late development has been the sectionalized steel hull of pontoons that can be quickly disassembled for moving to a new site. The wooden hulls in common use vary from 26 ft. by 30 ft. to 30 ft. by 40 ft. in deck area and draw from 13 inches to 36 inches of water.

No other method of working these shallow deposits with power equipment, except the smallest of the bucket dredgers, appears to have been as successful on limited acreage or as cheap in operating cost as the mobile drag-line of the type described. Shovels with steam, gasoline or Diesel power have been tried for short periods at many places, usually loading trucks to transport gravel to stationary washing plants. The operating cost with these outfits is comparatively high. The stationary plant, whether fed by a shovel, fixed drag-line or tractor-operated scrapers, is likely to be surrounded by tailing piles in a short time and thus put out of business unless the tailings are moved.

The small bucket dredger, with buckets of 2½ to 4 cu. ft. capacity has distinct advantages over the drag-line. It not only allows a more uniform feed to the washing plant, but with extensions on the digging ladder will permit working considerably deeper than the 18- to 20-ft. limit of the drag-lines.

ASSESSMENT WORK ON MINING CLAIMS WITHIN WITHDRAWN AREAS

In the October, 1934, quarterly chapter of CALIFORNIA JOURNAL OF MINES AND GEOLOGY, we quoted in full the case of *Ickes, Secretary of the Interior,* vs. *Virginia-Colorado Development Corporation,* in which the Court of Appeals of the District of Columbia affirmed the judgment of the lower court that the "government can not challenge right to mining claims for failure to perform annual assessment work within withdrawn areas." The Secretary of the Interior appealed the case to the Supreme Court of the United States, and they in turn have affirmed the judgment of the lower court. This decision of the Supreme Court is given herewith in full:

HAROLD L. ICKES, *as Secretary of the Interior, Petitioner,*

VS.

VIRGINIA-COLORADO DEVELOPMENT CORPORATION.

(295 U. S. 639-647)

Mines, § 18—exception clause in Mineral Leasing Act—applicability.

1. A locator of a mining claim under Rev. Stat. § 2324 (U. S. C. title 30, § 28), is protected from forfeiture at the instance of the United States for failure to perform the annual assessment work required by the statute, by the exception made by the Mineral Leasing Act of February 25, 1920, chap. 85, 41 Stat. at L. 437, 30 U. S. C. §§ 181, 193, of "valid claims existent at date of the passage of this act and thereafter maintained in compliance with the laws under which initiated."

Mines, § 28—mining claim—nature of interest or title.

2. When the location of a mining claim is perfected under the law, it has the effect of a grant by the United States of the right of present and exclusive possession, and is "property" in the fullest sense of the term, and as such is alienable, inheritable, and taxable.

Mines, § 18—effect of failure to perform development work.

3. Failure to perform development work on a mining claim located under Rev. Stat. § 2324 (U. S. C. title 30, § 28) does not ipso facto forfeit the claim, but only renders it subject to loss by relocation before work is resumed.

Mines, § 23—forfeiture of mining claim—grounds.

4. The Secretary of the Interior has authority, by appropriate proceedings, to determine that a mining claim is invalid for lack of discovery, fraud, or other defect, or that it is subject to cancellation by reason of abandonment.

Pleading, § 103—motion to dismiss—admission of facts alleged.

5. The allegations of a bill are admitted by motion to dismiss.

[No. 23]

Argued October 16, 1934. Decided June 3, 1935.

On Writ of Certiorari to the Court of Appeals of the District of Columbia to review a decree affirming a decree of the Supreme Court of the District of Columbia

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NOTE.—On annual assessment work on mines—see annotation in 42 L. ed. U. S. 96.

On ownership of mines—see annotation in 17 L. ed. U. S. 448.

On abandonment of mines—see annotation in 42 L. ed. U. S. 96.

On location of mining claims—see annotation in 7 L. R. A. (N.S.) 763.

As to when mining claim becomes segregated from public domain so as to be no longer subject to requirement as to assessment work or liable to relocation—see annotation in 38 L. R. A. (N.S.) 1121.

On effect or performance of or contribution to assessment work by one not owner of legal title or his agent to prevent forfeiture of mining claim—see annotation in 9 L. R. A. (N.S.) 1136.

On effect of act or joint resolution of Congress suspending requirement of assessment work on mining claims—see annotation in 15 A. L. R. 942.

As to character of work or expenditure which may be credited to annual assessment or improvement work—see annotation in 14 A. L. R. 1463.

requiring the Secretary of the Interior to vacate certain adverse proceedings and his decision declaring certain placer claims of the plaintiff to be void. Affirmed.

See same case below, 63 App. D. C. 47, 69 F. (2d) 123.

Assistant Attorney General HARRY W. BLAIR, of Washington, D. C., argued the cause, and, with Solicitor General Biggs and Messrs. H. Brian Holland and C. E. Collett, all of Washington, D. C., filed a brief for petitioner:

The claim in question had become defeasible by reason of the failure to comply with § 2324, Rev. Stat. U. S. C. title 30, § 28.

Wilbur v. United States, 280 U. S. 306, 74 L. ed. 445, 50 S. Ct. 103; Gwillim v. Donnellan, 115 U. S. 45, 48, 29 L. ed. 348, 349, 5 S. Ct. 1110; El Paso Brick Co. v. McKnight, 233 U. S. 250, 256, 58 L. ed. 943, 947, 34 S. Ct. 498, L. R. A. 1915A, 1113; Union Oil Co. v. Smith, 249 U. S. 337, 349, 63 L. ed. 635, 641, 39 S. Ct. 308; Cole v. Ralph, 252 U. S. 286, 295, 64 L. ed. 567, 576, 40 S. Ct. 321; Black v. Elkhorn Min. Co. 163 U. S. 445, 450, 41 L. ed. 221, 223, 16 S. Ct. 1101; Chambers v. Harrington, 111 U. S. 350, 353, 28 L. ed. 452, 454, 4 S. Ct. 428; United States ex rel. McLennan v. Wilbur, 283 U. S. 414, 75 L. ed. 1148, 51 S. Ct. 502; West v. Work, 56 App. D. C. 191, 11 F. (2d) 828, writ of certiorari denied in 271 U. S. 689, 70 L. ed. 1153, 46 S. Ct. 639; Peachy v. Frisco Gold Mines Co. (D. C.), 204 F. 659; Lindley, Mines, 3d ed. §§ 642–644.

Mr. LOUIS TITUS, of Washington, D. C., argued the cause, and, with Mr. Charles L. Frailey, of Washington, D. C., filed a brief for respondent:

Prior to passage of the Leasing Act a failure to do assessment work did not affect the validity of a mining claim.

Wilbur v. United States, 280 U. S. 306, 74 L. ed. 445, 50 S. Ct. 103.

Prior to the Leasing Act the Secretary of the Interior had no power to declare a mining claim forfeited for failure to do assessment work.

Cameron v. United States, 252 U. S. 450, 64 L. ed. 659, 40 S. Ct. 410; Black v. Elkhorn Min. Co., 163 U. S. 445, 41 L ed. 221, 16 S. Ct. 1101; Farrell v. Lockhart, 210 U. S. 142, 52 L. ed. 994, 28 S. Ct. 681, 16 L. R. A. (N. S.) 162; Brown v. Gurney, 201 U. S. 184, 50 L. ed. 717, 26 S. Ct. 509.

The Leasing Act gave the Secretary no power to declare claims forfeited for lack of assessment work; on the contrary, that act specifically preserved all rights as to valid existing claims

38 C. J. pp. 334–337: Wilbur v. United States, 280 U. S. 306, 74 L. ed. 445, 50 S. Ct. 103; Knutson v. Fredlund, 56 Wash. 634, 106 P. 200.

The right of locator to maintain his claim by resuming assessment work can not be taken away by implication nor by reading into the statute something which is not there.

George Van Camp & Sons Co. v. American Can Co., 278 U. S. 245, 73 L. ed. 311, 49 S. Ct. 112, 60 A. L. R. 1060; Thompson v United States, 246 U. S. 547, 62 L. ed. 876, 38 S. Ct. 349; Commissioner of Immigration v. Gottlieb, 265 U. S. 310, 68 L. ed. 1031, 44 S. Ct. 528; Corona Coal Co. v. United States, 263 U. S. 537, 68 L. ed. 431, 44 S. Ct. 156; United States v. First Nat. Bank, 234 U. S. 245, 58 L. ed. 1298, 34 S. Ct. 846.

Mr. Chief Justice HUGHES delivered the opinion of the Court.

The Virginia-Colorado Development Corporation brought this suit to obtain a mandatory injunction against the Secretary of the Interior requiring him to vacate certain adverse proceedings and his decision declaring certain placer claims of the plaintiff to the void. Motion to dismiss the bill of complaint was denied and, on defedant's refusal to plead further, plaintiff obtained a decree which the Court of Appeals affirmed. 63 App. D. C. 47, 69 F. (2d) 123. This Court granted a writ of certiorari (292 U. S. 620, 78 L. ed. 1477, 54 S. Ct. 780) in view of the question as to the construction of the Mineral Leasing Act, February 25, 1920, chap. 85, 41 Stat. at L. 437, U. S. C. title 30, §§ 181, 193.

Headnote 1

*The bill alleged that in June, 1917, under § 2324 of the Revised Statutes (U. S. C. title 30, § 28), plaintiff located certain oil shale placer claims on mineral lands of the United States in Colorado and thereupon became the owner of the claims and entitled to their exclusive possession; that from that time until, and including, the year ending July 1, 1930, the annual assessment work required by the statute was performed on each of the claims; that during the year ending July 1, 1931, the assessment work was not performed and had not been resumed before September 4, 1931, or since, but that plaintiff then intended to resume work, and had made arrangements for that resumption which would have been had but for the action of defendant; that plaintiff had not abandoned, or intended to abandon, any of the claims and that no charge to that effect had been made; that about September 4, 1931, adverse proceedings were initiated by the Department of the Interior, through the General Land Office, with the filing of a "challenge" to plaintiff's title and right of possession and by "posting such challenge on the said claims;" that the challenge was based on the sole ground that plaintiff had not performed the annual assessment work and that "the United States resumed possession of said land."

Plaintiff further alleged that there had been "no relocation of any of the claims by any person since plaintiff's failure to perform the annual assessment work, and that there had been no application by anyone to lease any of the claims from the United States." Plaintiff recited the answer he had made to the challenge, in substance, that notwithstanding his failure to perform the described work, he had the right to retain possession of the claims and to resume work thereon "at any time prior to a valid subsequent location of said claims;" but that the Commissioner of the General Land Office had held that the claims were null and void, and

*[644]

his ruling had been affirmed * by the Secretary of the Interior whose decision had been promulgated declaring that the United States had taken possession for its own purposes, thus in effect decreeing a forfeiture.

Plaintiff then set forth the provisions of the Mineral Leasing Act of February 25, 1920, which authorized the Secretary of the Interior to execute leases of mineral lands, but contained an exception as to valid claims existing on the date of the passage of the Act "and thereafter maintained in compliance with the laws under which initiated, which claims may be perfected under such laws, including discovery." [1]

1. The character and extent of the right which plaintiff acquired by virtue of its location of the mining claims, in 1917, are well established. Restating the rule declared by many decisions, we said in Wilbur v. United States, 280 U. S. 306, 316, 74 L. ed. 445, 449, 50 S. Ct. 103, that such a location, **Headnote 2** perfected under the law, "has the effect of a grant by the United States of the right of present and exclusive possession. The claim is property in the fullest sense of that term." It is alienable, inheritable, and taxable. See Forbes v. Gracey, 94 U. S. 762, 767, 24 L. ed. 313, 314; Belk v. Meagher, 104 U. S. 279, 283, 26 L. ed. 735, 737; Manuel v. Wulff, 152 U. S. 505, 510, 511, 38 L. ed. 532, 534, 14 S. Ct. 651; Elder v. Wood, 208 U. S. 226, 232, 52 L. ed. 464, 466, 28 S. Ct. 263;

*[645]

Bradford v. Morrison, 212 U. S. 389, *394, 53 L. ed. 564, 567, 29 S. Ct. 349. Under § 2324 of the Revised Statutes (U. S. C. title 30, § 28), the **Headnote 3** owner is required to perform labor of the value of $100 annually, but a failure to do so does not *ipso facto* forfeit his claim, but only renders it subject to loss by relocation. The law is clear "that no relocation can be made if work be resumed after default and before such relocation." Thus, prior to the passag of the Leasing Act of 1920, the annual performance of labor "was not necessary to preserve the possessory right, with all the incidents of ownership above stated, as against the United States, but only as against subsequent relocators. So far as the government was concerned, failure to do assessment work for any year was without effect. Whenever $500 worth of labor in the aggregate had been performed, other requirements aside, the owner became entitled to a patent, even though in some years annual assessment labor had been omitted." Wilbur v. United States, 280 U. S. 306, 74 L. ed. 445, 50 S. Ct. 103, supra.

There was authority in the Secretary of the Interior, by appropriate proceedings, to determine that a claim was invalid for lack of discovery, fraud, or other defect, or that it was subject to cancellation by reason of **Headnote 4** abandonment. Cameron v. United States, 252 U. S. 450, 460, 64 L. ed. 659, 662, 40 S. Ct. 410; Cole v. Ralph, 252 U. S. 286, 296, 64 L. ed. 567, 577, 40 S. Ct. 321; Black v. Elkhorn Min. Co. 163 U. S. 445, 450, 41 L. ed. 221, 223, 16 S. Ct. 1101; Brown v. Gurney, 201 U. S. 184, 192, 193, 50 L. ed. 717, 721, 722, 26 S. Ct. 509; Farrell v. Lockhart, 210 U. S. 142, 147, 52 L. ed. 994, 997, 28 S. Ct. 681, 16 L. R. A. (N. S.) 162.

2. The Leasing Act of 1920 inaugurated a new policy. Instead of the acquisition of rights by location, the Act provided for leases. But by express provision, the Act saved existing valid claims "thereafter maintained in compliance with the laws under which initiated, which claims may be perfected under such laws." (§ 37.[2]) What then was the status of plaintiff's claims under this exception? They were originally valid claims. No question is raised to the contrary. There is no

*[646]

suggestion of * lack of discovery, fraud or other defect. There is no ground for a charge of abandonment. The allegations of the bill, admitted by the motion to dismiss, dispose of any such contention. Plaintiff had lost no rights **Headnote 5** by failure to do the annual assessment work; that failure gave the government no ground of forfeiture. Wilbur v. United States, 280 U. S. 306, 74 L. ed. 445, 50 S. Ct. 103, supra.

How could the valid claims of plaintiff be "thereafter maintained in compliance with the laws under which initiated"? Manifestly, by a resumption of work. Plaintiff was entitled to resume, and the bill alleged that plaintiff had made arrangements for resumption, and that work would have been resumed if the Department of the Interior had not intervened. Plaintiff's rights after resumption would have been as if "no default had occurred." Belk v. Meagher, 104 U. S. 279, 26 L. ed. 735, supra. Such a resumption would have been an act "not in derogation but in affirmance of the original location," and thereby the claim would have been "maintained." As we said in Wilbur v. United States, supra (280 U. S. p. 318, 74 L. ed. 449, 50 S. Ct. 103). "Such resumption does not *restore a lost* estate * * *; it *preserves* an *existing* estate."

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[1] Section 37 of the Act of February 25, 1920, chap. 85, 41 Stat. at L. 437, 451 (U. S. C. title 30, § 193) is as follows:

"Sec. 37. That the deposits of coal, phosphate, sodium, oil, oil shale, and gas, herein referred to, in lands valuable for such minerals, including lands and deposits described in the joint resolution entitled 'Joint resolution authorizing the Secretary of the Interior to permit the continuation of coal mining operations on certan lands in Wyoming,' approved August 1, 1912 (37 Stat. at L. p. 1346, No. 38, U. S. C. title 30, § 193), shall be subject to disposition only in the form and manner provided in this Act, except as to valid claims existent at date of the passage of this Act and thereafter maintained in compliance with the laws under which initiated, which claims may be perfected under such laws, including discovery."

[2] See note 1.

In this view, plaintiff came directly within the exception. The Government invokes the new policy of the Leasing Act abolishing the practice of location. But the saving provision of § 37 is a part of the policy of the Act. Its terms explicitly declare the will of Congress as to valid existing claims, with full understanding of the status of such claims under the prior law.

The Government refers to the reservation in the opinion in Wilbur v. United States, supra, as to the maintenance of a claim by a resumption of work "unless at least some form of challenge on behalf of the United States to the valid existence of the claim has intervened." But that was a reservation, not a decision, and it

does not aid the Government in its contention here. To be effective, the *"challenge" to the "valid existence" of a claim must have some proper basis. No such basis is shown.

We think that the Department's challenge, its adverse proceedings, and the decision set forth in the bill went beyond the authority conferred by law. The decree is affirmed.

JOSHUA TREE NATIONAL MONUMENT

Under date of August 10, 1936, the President of the United States set aside an area of 825,430 acres, or 1290 square miles in Riverside and San Bernardino counties of California, as the ''Joshua Tree National Monument,'' prohibiting further entry therein under the public-land laws. An examination of the map attached shows that this newest national monument includes within its boundaries the principal mineral sections of Riverside County. They are:

Twenty-nine Palms and Virginia Dale mining districts located on the boundary of San Bernardino and Riverside counties. This section is very active at the present time and a number of properties are being developed. The Gold Crown Mining Company, whose property is located on the boundary line of San Bernardino and Riverside counties, southwest of Twenty-nine Palms, has installed a 50-ton cyanide plant and is operating full capacity.

Another district included in this area is the Pinto Mountain, known as the Pinto Basin Mining District. In this district, such properties as the Desert Queen, El Dorado and Lost Horse have been producers and there is considerable activity and prospecting in this area.

In the Eagle Mountains, the principal deposits are of iron. In this area is the Iron Chief Mine which was a former producer of copper and gold ores and the Black Eagle Mine which has produced considerable lead-silver, gold and copper ore and is at present under production.

In the Cottonwood Mountains, there is a custom plant now under operation treating ore from different small properties in that area.

While the proclamation recognizes valid existing claims and to that extent will not prevent continued operations of going properties noted in the foregoing list, the national monument status will prevent location of any more new mining claims, or claims covering extension of orebodies being now worked in existing claims. The same situation ensued several years ago when the Death Valley Monument was created; and was subsequently corrected by a Congressional amendment, permitting location and operation of mining claims within the withdrawn area. This will have to be done for the Joshua Tree National Monument; otherwise the State of California and the Nation will lose much by the retarded development of the valuable mineral resources of the area involved.

JOSHUA TREE NATIONAL MONUMENT—CALIFORNIA

By the President of the United States of America

A PROCLAMATION

WHEREAS, certain public lands in the State of California contain historic and prehistoric structures, and have situated thereon various objects of historic and scientific interest; and

WHEREAS, it appears that it would be in the public interest to reserve such lands as a national monument, to be known as the Joshua Tree National Monument:

NOW, THEREFORE, I, FRANKLIN D. ROOSEVELT, President of the United States of America, under and by virtue of the authority vested in me by section 2

DEPARTMENT OF THE INTERIOR

NATIONAL PARK SERVICE

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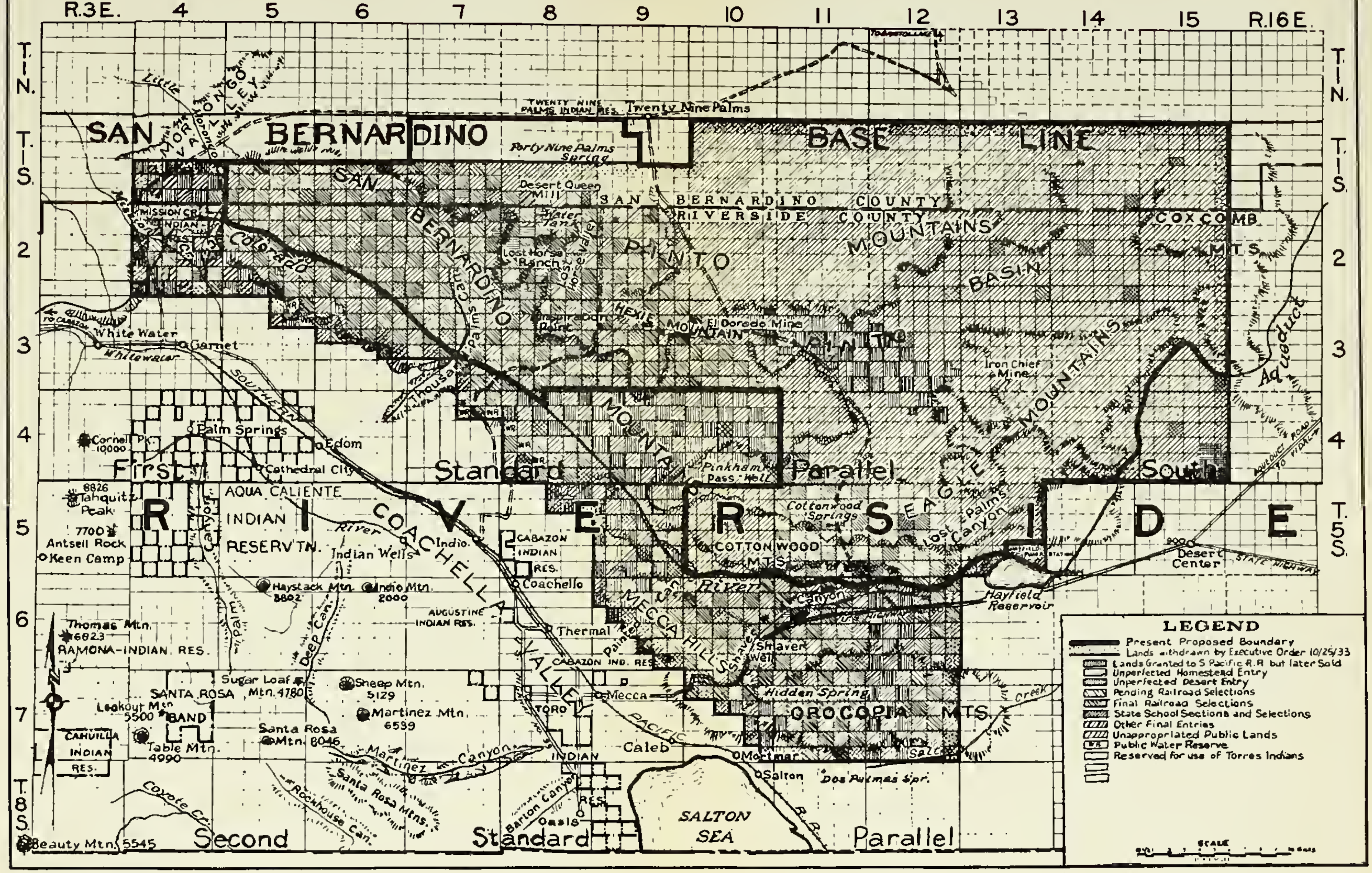
JOSHUA TREE NATIONAL MONUMENT
CALIFORNIA


R.3E.
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T.1S.
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T.5S.
6
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T.8S.
SAN BERNARDINO BASE LINE
Twenty Nine Palms
TWENTY NINE PALMS INDIAN RES.
Forty Nine Palms Spring
Little Morongo Valley
Morongo Valley
SAN BERNARDINO MOUNTAINS
Desert Queen Mill
Water Tank
Lost Horse Ranch
Lost Horse Valley
PINTO MOUNTAINS
PINTO BASIN
SAN BERNARDINO COUNTY
RIVERSIDE COUNTY
COXCOMB MTS.
HEXIE MOUNTAIN
El Dorado Mine
Iron Chief Mine
EAGLE MOUNTAINS
Inspiration Point
MISSION CR. INDIAN RES.
Colorado
Palms Canyon
Thousand Palms Canyon
White Water
Whitewater
Garnet
SOUTHERN PACIFIC R.R.
Palm Springs
Edom
Cathedral City
Cornell Pk. 10000
First Standard Parallel South
Tahquitz Peak 8826
Antsell Rock 7700
Keen Camp
AQUA CALIENTE INDIAN RESERV'TN.
RIVERSIDE
COACHELLA VALLEY
Indio
Indian Wells
CABAZON INDIAN RES.
Coachella
Pinkham Pass Well
Cottonwood Springs
COTTONWOOD MTS.
Lost Palms Canyon
Hayfield Reservoir
Desert Center
STATE HIGHWAY
Aqueduct
Haystack Mtn. 3802
Indio Mtn. 2000
AUGUSTINE INDIAN RES.
Thermal
MECCA HILLS
Painted Canyon
Shaver Well
Hidden Spring
OROCOPIA MTS.
Salt Creek
CABAZON IND. RES.
Mecca
TORO INDIAN RES.
Caleb
Mortmar
Salton
Dos Palmas Spr.
SALTON SEA
Oasis
Barton Canyon
Thomas Mtn. 6823
RAMONA INDIAN RES.
Sugar Loaf Mtn. 4780
Sheep Mtn. 5129
SANTA ROSA BAND
Lookout Mtn 5500
Martinez Mtn. 6539
Santa Rosa Mtn. 8046
CAHUILLA INDIAN RES.
Table Mtn. 4990
Martinez Canyon
Santa Rosa Mtns.
Rockhouse Can.
Deep Can.
Palm Canyon
Coyote Cr.
Beauty Mtn. 5545
Second Standard Parallel
LEGEND
Present Proposed Boundary
Lands withdrawn by Executive Order 10/25/33
Lands Granted to S Pacific R.R but later Sold
Unperfected Homestead Entry
Unperfected Desert Entry
Pending Railroad Selections
Final Railroad Selections
State School Sections and Selections
Other Final Entries
Unappropriated Public Lands
Public Water Reserve
Reserved for use of Torres Indians
SCALE

PHYSICAL
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of the act of June 8, 1906, ch. 3060, 34 Stat. 225 (U. S. C., title 16, sec. 431), do proclaim that, subject to existing rights and prior withdrawals, the following-described lands in California are hereby reserved from all forms of appropriation under the public-land laws and set apart as the Joshua Tree National Monument:

SAN BERNARDINO MERIDIAN

T. 1 S., R. 5 E., secs 19 to 36, inclusive.

T. 2 S., R. 5 E., secs. 1 to 6, 11 to 13, inclusive, and those parts of secs. 7, 8, 9, 10, 14, 15 and 24 lying north of the north boundary of the Colorado River Aqueduct right-of-way.

T. 1 S., R. 6 E., secs 19 to 36, inclusive.

T. 2 S., R. 6 E., secs. 1 to 18, 21 to 26, inclusive, and those parts of secs. 19, 20, 27, 28, 34, 35 and 36 lying north of aqueduct right-of-way.

T. 3 S., R. 6 E., that part of sec. 1 lying north of aqueduct right-of-way.

Ts. 1 and 2 S., R. 7 E. (partly unsurveyed).

T. 3 S., R. 7 E., secs. 1 to 6, 8 to 16, 23 to 24, inclusive, and those parts of secs 7, 17, 18, 21, 22, 25 and 26 lying north of aqueduct right-of-way.

Ts. 1 and 2 S., R. 8 E. (partly unsurveyed).

T. 3 S., R. 8 E., secs. 1 to 30, 33 to 36, inclusive, and those parts of secs. 31 and 32 lying north of aqueduct right-of-way.

T. 4 S., R. 8 E., those parts of secs 4 and 5 lying north of aqueduct right-of-way.

T. 1 S., R. 9 E., secs. 5 to 9 and 16 to 36, inclusive.

Ts. 2 and 3 S., R. 9 E. (partly unsurveyed).

Ts. 1 to 3 S., R. 10 E. (partly unsurveyed).

T. 5 S., R. 10 E., secs. 1 to 30, inclusive, and those parts of secs. 31 to 36 lying north of aqueduct right-of-way.

Ts. 1 to 4 S., R. 11 E. (partly unsurveyed).

T. 5 S., R. 11 E., secs. 1 to 30 and 32 to 36, inclusive, and that part of sec. 31 lying north of aqueduct right-of-way.

T. 6 S., R. 11 E., those parts of secs. 1 to 6 lying north of aqueduct right-of-way.

Ts. 1 to 5 S., R. 12 E. (partly unsurveyed).

T. 6 S., R. 12 E., those parts of secs. 1 to 6 lying north of aqueduct right-of-way.

Ts. 1 to 4 S., R. 13 E. (partly unsurveyed).

T. 5 S., R. 13 E., secs. 1 to 24, inclusive, and those parts of secs. 28, 29, 30 and 31 lying north of aqueduct right-of-way (partly unsurveyed).

Ts. 1 to 3 S., R. 14 E. (partly unsurveyed).

T. 4 S., R. 14 E., secs. 1 to 11, 14 to 23, 27 to 34, inclusive, and those parts of secs. 12, 13, 24, 25, 26 and 35 lying west of aqueduct right-of-way (unsurveyed).

Ts. 1 and 2 S., R. 15 E. (partly unsurveyed).

T. 3 S., R. 15 E., secs. 1 to 19, inclusive, and sec. 24; those parts of secs. 20, 21, 22, 23, 25, 26, 29, 30 and 31 lying north of aqueduct right-of-way (partly unsurveyed).

T. 4 S., R. 15 E., those parts of secs. 6 and 7 lying west of aqueduct right-of-way;

containing approximately 825,340 acres.

Warning is hereby expressly given to all unauthorized persons not to appropriate, injure, destroy, or remove any feature of this monument and not to locate or settle upon any of the lands thereof.

The Director of the National Park Service, under the direction of the Secretary of the Interior, shall have the supervision, management, and control of the monument as provided in the act of Congress entitled, "An act to establish a National Park Service, and for other purposes," approved August 25, 1916 (ch. 408, 39 Stat. 535, U. S. C., title 16, secs. 1 and 2), and acts supplementary thereto or amendatory thereof.

IN WITNESS WHEREOF, I have hereunto set my hand and caused the seal of the United States to be affixed.

DONE at the City of Washington this 10th day of August, in the year of our Lord nineteen hundred and thirty-six and of the Independence of the United States of America the one hundred and sixty-first.

(signed) FRANKLIN D. ROOSEVELT.

William Phillips (signed),
Acting Secretary of State.

COST OF PRODUCING QUICKSILVER AT A CALIFORNIA MINE IN 1931–1932

Some detailed and informative cost data covering operations of the Bumsted Mining Company at the Great Western Mine, Middletown, California, in 1931 and 1932, have been supplied by E. J. Bumsted, president of the company, and he has generously granted permission to publish them for the benefit of the industry.

PRODUCTION AND PER TON COST, PERIOD OCTOBER 1, 1931, TO APRIL 1, 1932

	October	November	December	January	February	March
Mining:						
Labor	$0 66	$1 47	$1 22	$1 19	$1 23	$1 44
Supplies	------	07	08	08	05	31
Totals, mining	$0 66	$1 54	$1 30	$1 27	$1 28	$1 75
Treatment:						
Labor	$1 56	$0 86	$1 05	$0 93	$0 75	$0 74
Supplies	06	15	03	10	10	03
Maintenance	36	29	12	03	03	11
Fuel oil	44	65	46	68	45	56
Power	17	13	16	14	14	13
Empty flasks	16	14	10	07	06	17
Totals, treatment	$2 75	$2 22	$1 92	$1 95	$1 53	$1 74
General:						
Management	$0 89	$0 55	$0 66	$0 53	$0 47	$0 46
Audit and legal	15	05	------	09	05	08
General insurance	36	------	------	------	04	------
Comp. insurance	------	57	------	------	55	------
Taxes	------	28	------	------	------	05
Office and assay	15	02	02	03	02	02
Wires and phone	02	01	01	02	02	02
Lights	06	02	04	03	02	02
Auto and truck	08	06	29	08	02	03
Road work	34	------	21	06	03	------
Miscellaneous	17	02	02	04	70	06
Totals, general	$2 22	$1 58	$1 25	$0 88	$1 92	$0 74
Totals, operating	$5 63	$5 34	$4 47	$4 10	$14 73	$4 23
Tons treated	336	542	446	562	641	658
Flasks produced	64	76	70	80	60	70
Cost per flask	$29 60	$38 10	$28 35	$28 81	$50 57	$39 73
Mercury recovered per ton treated	14 5 lbs.	10.6 lbs.	11.9 lbs.	10.8 lbs.	7.1 lbs.	8.1 lbs.

Selling costs, depreciation and depletion are not included. October figures are inaccurate, as plant was just starting and cost system not established.

Average selling costs; per flask:

Hauling to railroad (18 miles)	$0.17
Freight to San Francisco	.27
Cartage to steamer	.12
Marine insurance	.08
Ocean freight to New York	.47
Cartage in New York	.18
Brokerage in San Francisco	1.00
Brokerage in New York	1.35
Total selling cost per flask	3.64
New empty flasks, costing (included under ‘treatment’)	0.80

Fuel oil, 27 gravity, cost 5¢ per gallon delivered at mine.

Fuel oil consumption, averages 10 gallon per ton dry ore treated.

The following are the results of operations for the year 1932:

Tons treated	5,922
Mercury recovered	619 flasks
Recovery, per ton	7.9 lbs. Hg.
Operating cost, per ton	$4.50
Total cost, per ton	$4.93
Furnace capacity	20 tons daily
Fuel oil	10 gallons per ton
Cost of fuel oil	5¢ per gallon at mine.
Power, per ton, for furnace plant	16¢
Lights, per ton, for camp and plant	3.2¢

THE AGE OF MINERAL UTILIZATION[1]

JOHN WELLINGTON FINCH, Director, U. S. Bureau of Mines

The present epoch in human history has been variously described as the age of coal, of oil, of iron and steel, of power. Others have called it the age of minerals. All agree, however, that it is a great industrial period.

Power is of course the vital force in the industrial organism. It is chiefly derived from mineral fuels, and from harnessed and controlled water—also a mineral substance but not so classified from the industrial viewpoint.

Power is applied energy. The latent energy of fuels is useless to man until converted into active energy by combustion. It can then be used through mechanisms and devices that convert it into motion. These are just as indispensable as the energy itself. Such devices and the structures in which they are operated are made of metals and other minerals. The strength of metals is called upon to transmit power through propelling pistons, revolving shafts and gears and electric transmission lines, to do titanic work beyond the strength of human hands. Thus metals and fuels are intimately interwoven in their industrial uses.

The nonmetallic minerals, too, are of great importance. They insulate and save heat energy, line our furnaces, form our crucibles, encase our spark plugs, form the bulk of industrial and commercial structures, and surface our roads and streets. By themselves they constitute an enormous industry and now create more new wealth each year than the metals and only slightly less than coal or petroleum.

The minerals, therefore, through engineering science, have become the foundation of industrial civilization. But the mere possession of minerals, or other natural resources, does not of itself create an industrial civilization, as can be seen in many backward countries that are richly endowed with them. It is the utilization of mineral raw materials that counts, and that is what this country has done to a superlative degree. For this reason a better name than any that has been suggested for these present times in the United States is the *age of mineral utilization.*

Mineral utilization in our country has brought more human benefit than in any other country, though the transition from an agricultural society to an industrial one came much later than in England, Germany, and other European countries. The United States was settled by intelligent, fearless and enterprising pioneers. They were heirs to technologic arts, developed in Europe through many centuries, for the utilization of natural resources. Once started, our pioneers were ingenious and tireless in devising and inventing new and better ways of doing things—in mining, milling, smelting, refining and in manufacturing new and better products. Before the beginning of this century American mineral technology had become preeminent in the world.

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[1] Presented at annual conference of Association of American State Geologists, at Washington, D. C., Feb. 21, 1936.

The achievements of our mining technologists shaped the destiny of the country. The territory was so large that its permanent unification under a single government would have been difficult if not impossible had it not been for the railroads and telegraph lines that linked its parts together and for the utilization of the supplies of metals needed to build these lines and of the fuel to operate them. This gigantic task was made possible by inventive American engineers and courageous American capital.

The contribution of the mining industry to the railroads did not cease, by the way, with their construction. It has continued to supply the bulk of their traffic reckoned either by tonnage or revenue. In a recent year minerals and their derivatives provided 74 per cent of the freight tonnage of railroads and 55 per cent of their revenue.

To return to our development as a nation, it is not generally understood how critical in the preservation of the Union in 1864 was the gold mined in the western states, nor how enormously our national industrial development was accelerated by this early gold output and the later volume of silver from the west.

More recently the astounding development of mineral oil and the utilization of its products have created a new epoch of rapid transport by automobiles, buses, and trucks and these have been the cause of the rapid construction of our wonderful highway system.

Importance of the Mineral Industry

At the end of 1934 our country had produced from its mines 229,301,000 ounces of gold, 3,275,891,000 ounces of silver, 27,649,630,000 pounds of zinc, 46,974,051,000 pounds of copper, 39,015,184,000 pounds of lead. A great part of this production has been made since the beginning of the present century. In the prosperous ten years 1921–1930, about 10% of the total production of gold was made, 18% of the total silver, 32% of the total copper, 30% of the lead, and 36% of the zinc. This acceleration of production has been adding rapidly to the national wealth. Our country ranks first in the world in copper, lead, and zinc output.

The United States has been the chief consumer of the metals. From 1921–1930, we consumed 39 per cent of all the lead the world produced, 40 per cent of the zinc, 50 per cent of the copper. Our monetary requirements for gold and silver have been enormous, and our use of silver in the arts and industries exceeds that of any other country.

Then, too, the value of all our nonferrous metal production is only about one-fourth of the value of our whole mineral output. The balance is supplied by iron, coal, oil and the nonmetallic minerals; coal and petroleum products amount to 52 per cent, all metals and nonmetals to 48 per cent.

Our average annual production of all minerals for 10 years before the depression was five and one-third billions of dollars.

Our share in consumption of world production of coal was 37 per cent, of pig iron 47 per cent, of petroleum 75 per cent. We consumed as much as we produced of the nonmetallics.

This picture of the stupendous value of mineral raw materials as they come from the earth shows merely their commodity value. They have a much greater value in use, as will be explained. Our mineral output apparently amounts in value to only about a third of the value of all raw materials produced in the country. Agricultural people use that figure to emphasize the importance of their contribution to the national wealth. They neglect to state that their products are consumed as produced and must be replaced annually. Agricultural materials are essential for supporting life, but their production now-a-days depends upon implements supplied by the mineral industries. The farmer would not choose to return to the wooden plow or to winnowing grain in the wind. Even the cattleman on the ranges relies upon rails to deliver his beef to market.

So minerals are not only indispensable for supporting manufacture, transportation, and communication but play an essential part in supporting life.

Now let us return again to consideration of the age of mineral utilization, and analyze the values that are created by utilization. Our metal and nonmetal mineral consumption, excepting fuels, is not, as in the case of foods, generally destructive. Minerals enter into an accumulating store of national wealth. More than half of them enter into enduring facilities: Buildings, metal and concrete bridges, roads, railroads, power-transmission and communication lines, water, sewage and drainage systems. Much of the balance goes into temporary usage in machines, industrial, farm, and household tools and utensils, but a large part of the metals thus used are not consumed and destroyed but become permanent by returning as scrap to be refabricated, thus continuing in a revolving mineral fund.

Great areas of the west have boasted that they are strictly agricultural communities. In the past few years mines were closed or curtailed operations and the communities where this happened discovered that more than half their population had really depended upon mining. Close the mines and quarries for ten years until present farm and household equipment wears out, city structures deteriorate and become obsolete, rails have to be replaced, storms blow wires from their poles, generators and motors fail to perform—do this and even farmers would be marching upon Congress to reestablish the mineral industry.

In the past 25 years the annual value of farm production increased 17 per cent. The annual value of mineral products increased 77 per cent, in step with an expanding industrial life—until the hard times struck us.

Value of Minerals in Use

Now let us consider further the enhanced value of some of the minerals as they enter into use. Iron ore sells, say, for about $2.50 a ton. Two tons of ore should yield one ton of finished steel selling from $30 to $100 per ton for the principal industrial uses, or an average of around $60,00 per ton. Here the raw material is enhanced 25 times in value. But, much of the ore is made into special alloys extensively used that sell from $100 per ton up to several dollars per pound, and here the increment becomes bewildering. One pound of hair springs used in watches is worth about $1,000,000, A ton is worth $2,000,000,000.

It is safe to say that copper, lead and zinc are at least tripled in value as the primary metal from the smelter passes into use as pipe, sheets, pigments and fabricated products.

The fuels, too, increase in value through preparation for some of their principal uses. Coal at $2.00 per ton yields products worth $16.25 as it is treated in coke ovens. We all know that crude petroleum at $1.00 a barrel of 41 gallons increases in value as it passes through refineries and the distribution system, for we pay 15 to 20 cents a gallon for gasoline, and a dollar or more for a gallon of lubricating oil.

The accrued value of steel and the chief nonferrous metals that have entered as raw materials into permanent or recurring use since 1800 is somewhat as follows:

About 1,150,000,000 tons of *steel* worth about $60,000,000,000.
About 47,000,000,000 lbs. of *copper* that sold for around 15 cents, therefore worth about $7,000,000,000 in the unfabricated state.
About 46,000,000,000 lbs. of *lead* worth around $2,400,000,000.
About 29,000,000,000 lbs. of *zinc* worth around $1,450,000,000.

This gives a total for steel and nonferrous metals of $60,850,000,000.

It appears safe to say that of this total $50,000,000,000 worth is still in use. Of the metals *lost* in use zinc suffers most, lead next, then iron and copper least. In fact, the return of scrap iron, steel and copper is one of the big problems confronting primary producers of these metals.

The nonmetallic minerals also take on a large added increment—the rock that enters concrete, building stone (300%), clay for high-grade brick and tile (100–250%). They are used in enduring structures that last for scores, even hundreds, of years and thus contribute to lasting wealth, but they do not return to new uses.

Consider the city of Chicago, or any similar city, its commercial and residence buildings, its streets underlain with some thousands of miles of pipes and cables, its thousands of metal automobiles, trucks, and buses, its fleets of metal lake-going vessels, its trains and tracks, great manufacturing establishments, its household utensils and mechanical equipment. What is the value of the city in fabricated metals and other minerals? Judging from assessment figures the actual value may be around $6,000,000,000.

Now lump together in imagination the same property items for the whole country and add the vast Army and Navy establishments, government buildings, aerial transport facilities and great commercial vessels of steel plying the seas. Exact figures do not exist, but you can deduct, I believe, from the total national wealth the public and private property represented by farm land and forests and feel assured that the mineral industry created the balance.

Agriculture can show as its part of the picture of national wealth only its productive land, since its products are destroyed as used. The forests supply lumber that formerly had somewhat lasting use, but in large construction lumber is now almost completely displaced by mineral products.

The entire wealth of the country in 1932 was given as $163,317,000,000. It is actually probably much more than this. From my point of view between 60 and 70 per cent of this had its origin in the mineral industries. Farm property including machinery and equipment in 1930 was valued by the census at $57,245,000,000. Land and buildings were given as $47,879,000,000, full value, or about 30 per cent of the total property value in the country. About 10 per cent might be allotted to forest property.

I am dwelling upon this picture solely to arouse our pride as mining men in our line of business, in the part we play in our modern civilization, and if possible to stiffen our backs so that we will stand up and insist upon recognition by a public that, although profiting through us, yet ignores and seems to be unaware of us.

ADMINISTRATIVE

WALTER W. BRADLEY, State Mineralogist

Personnel.

Mr. Herbert A. Franke, for the past seven years junior mining engineer and librarian in the San Francisco headquarters of the Division of Mines, has resigned to accept a position on the staff of the Economics Division of the U. S. Bureau of Mines in Washington, D. C.

New Publications.

'California Journal of Mines and Geology,' January, 1936, being Chapter I of State Mineralogist's Report XXXII. This chapter contains: 'Gold Mines of Placer County'; 'Borax Lake, California'; 'Estimate of 1935 Mineral Production of California'.

Commercial Mineral Notes (Nos. 157-159 inc.), May-July respectively. These 'Notes' contain the lists of 'mineral deposits wanted,' and 'mineral deposits for sale,' issued in the form of a mimeographed sheet monthly. It is mailed free to those on the mailing list for 'California Journal of Mines and Geology,' and to others on payment of 15 cents postage paid in advance for the year. As an evidence of the interest in mines and mineral resources now showing considerable activity, this mimeographed 'sheet' has had to be expanded to two and three pages in recent months.

Mails and Files.

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products, and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.

MINERALS AND STATISTICS

Statistics, Museum, Laboratory

HENRY H. SYMONS, Statistician and Curator

STATISTICS

Data on the 1935 production of several California minerals were given in the April issue of California Journal of Mines and Geology, and some additional ones are presented herein. Copy of the complete annual report for the year is now being prepared and will shortly go to the printer as Bulletin No. 112 of the Division of Mines.

COAL

Bibl.: State Mineralogist Reports VII, XII–XV (inc.), XVII, XIX–XXVIII (inc.), XXVI. U. S. Geol. Surv., Bulletins 285, 316, 431, 471, 581; Ann. Rept. 22, Pc. III.

The coal production in California during 1935 totaled 8,049 short tons valued at $32,745, as compared with the 1934 output, which was 13,549 tons worth $52,720. The material mined in 1935 came from a single property each, in Amador, Monterey, and Trinity counties. This coal was consumed by the local market and also used on the property for camp purposes, power and forge, to carry on regular operations and development work.

GRANITE

Bibl.: State Mineralogist Reports X, XII–XXVI (inc.), XXVIII. Bulletin 38.

The 1935 output of granite in California consisted of 88,306 cu. ft. of building stone valued at $213,093; 26,560 cu. ft. of monumental stone valued at $47,917; 11,300 linear ft. of curbing valued at $7,500, and 338,310 cu. ft. of unclassified material, including a small amount of tuff and volcanic rock, which was used as building stone and for flagstone, having a value of $71,407; giving a total value for the year's yield at $339,917. This was an increase over the 1934 total value which was $249,083. The 1935 material came from nineteen quarries in twelve counties, four of which were in San Diego County, three in Sonoma County, two each in Fresno and Madera counties, and one each in Lassen, Mariposa, Nevada, Plumas, Placer, Sacramento, Tulare, and Ventura counties. The material from San Luis Obispo, Sonoma, and Ventura counties was tuff.

So far as possible, granite production has been segregated in the statement herewith into the various uses to which the product was put. It will be noted, however, that a portion of the ouput has been entered under the heading 'Unclassified.' This is necessary because of the fact that some of the producers have no way of telling to what specific use their stone was put after they had quarried and sold the same in the rough.

Varieties.

For building purposes, the granites found in California, particularly the varieties from Raymond in Madera County, Rocklin in Placer County, and near Porterville in Tulare County, are unexcelled by any similar stone found elsewhere. The quantities available, notably at Raymond and Porterville, are unlimited. Most of California's 'granite,' particularly that found in the Sierra Nevada Mountains, is technically 'granodiorite' (that is, both plagioclase and orthoclase feldspars are present).

Granites of excellent quality for building and ornamental purposes are also quarried in Riverside and San Diego counties. Near Lakeside, San Diego County, there is a fine-grained, 'silver gray' granite of uniform texture and color, especially suited for monumental and ornamental work.

The Fresno County stone is a dark, hornblende diorite, locally called 'black granite,' whose color permits of a fine contrast of polished and unpolished surfaces, making it particularly suitable for monumental and decorative purposes. There is also a similar 'black granite' in Tulare County, near Success.

MARBLE

Bibl.: State Mineralogist Reports XII–XV (inc.), XVII–XXX (inc.). Bulletin 38. U. S. Bur. of Mines Bull. 106.

The 1935 production of marble in California was valued at $9,884 (including some onyx and travertine from Solano and San Bernardino counties, and a small amount of limestone used as building stone and flagstone coming from an operator in Santa Cruz County). The marble came from a single quarry in Tuolumne County. The 1935 output showed a decrease in value from that of 1934, which was worth $10,759.

California has many beautiful and serviceable varieties of marble, suitable for almost any conceivable purpose of construction or decoration. In the decorative class are deposits of onyx marble of beautiful coloring and effects. There is also serpentine marble suitable for electrical switchboard use.

PUMICE and VOLCANIC ASH

Bibl.: State Mineralogist Reports XII, XIV, XV, XVII, XVIII, XXII–XXVIII (inc.), XXX. Bulletin 38. U. S. Bureau of Mines I. G. 6560. (See 'Tufa.')

The production of pumice and volcanic ash in California during the year 1935 amounted to 14,890 short tons valued at $87,055, coming from three properties in Inyo County and one each in Imperial, Kern, Madera, Mono, Napa, San Luis Obispo, and Siskiyou counties. The 1935 output showed an increase in quantity and value over that of 1934, which was 9,951 tons worth $54,248.

The material from two of the deposits in Inyo County and from Imperial, Mono, Napa, and Siskiyou counties was 4,492 tons of pumice and was used in acoustic plaster, light-weight aggregate in concrete, for abrasive purposes and for chicken-house litter. The product from one property in Inyo and that from Kern, Madera and San Luis Obispo counties was 10,398 tons of volcanic ash or tuff variety and was employed in making soap, cleanser compounds, a large tonnage being utilized as a concrete filler in cement displacement, and in asphalt and as a carrier for dry agricultural sprays. The Kern County ash is going into the preparation of one of our popular and nationally advertised brands of cleanser compounds.

SANDSTONE

Bibl.: State Mineralogist Reports XII–XV, XVII, XVIII, XXI, XXIII, XXVI–XXVIII (inc.). Bulletin 38. U. S. Bur. of Mines, Bull. 124.

An unlimited amount of high-grade sandstone is available in California, but the wide use of concrete in buildings of every character, as well as the popularity of a lighter-colored building stone, has curtailed production in this branch of the mineral industry during recent years almost to the vanishing point. In 1935 a total of 38,426 cu. ft. of sandstone valued at $9,268, was quarried in California and came from six properties in Los Angeles, Monterey, and San Luis Obispo counties; compared with 21,738 cu. ft. valued at $14,245 for 1934.

Practically all of the material was flagstone which is used in garden walks, fountains, walls and fireplaces to give effect to Spanish and English types of homes. The material reported from Monterey and San Luis Obispo counties is in reality an indurated shale of the Monterey series, of a cream color and utilized as a building stone. Part of the material coming from Los Angeles County was schist and indurated shale.

A large portion of the sandstone was sold for landscape work and used as stepping stones for walks and for fountains, walls, etc.

SOAPSTONE and TALC

Bibl.: State Mineralogist Reports XII, XIV, XV, XVII–XXVII (inc.), XXX. Bulletins 38, 67, 91. U. S. Bur. of Mines, Bulletin 213. Rep. of Investigations, Serial No. 2253, May, 1921.

The total output of talc and soapstone in California during 1935 amounted to 17,332 short tons valued at $170,830. The 1935 figures showed an increase in both amount and value over those of 1934, which were 13,920 tons and $158,606. Of the 1935 production 16,541 tons were high-grade talc from Inyo and San Bernardino counties; this material was utilized mainly in toilet powder, paint, paper and rubber manufacture, and in ceramics. The remainder of 791 tons was soapstone and came from Butte and El Dorado counties.

The 'soapstone' grades were used mainly for roofing granules and as a filler in roofing paper, and part also in magnesite cement.

It is reported that California talc has replaced to some extent imported talc in the toilet trade on the basis of quality. The largest production of talc in the United States comes from Vermont and New York, and of massive soapstone from Virginia.

During 1935 imports of talc, steatite, etc., into the United States totaled 23,897 short tons valued at $492,274, as compared with 22,921 tons worth $368,014 during 1934, according to the United States Bureau of Foreign and Domestic Commerce.

The Tariff Act of 1930 places a duty on talc, steatite or soapstone and French chalk, crude or unground, of one-fourth of one cent per pound.

MUSEUM

The Museum of the State Division of Mines possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Division of Mines as well as by those who utilize the facilities of the collection.

Among the specimens received recently and catalogued for the Museum are the following:

20676 PRASE OPAL.
From Lone Pine Chrome Mine.
3½ miles from Knoxville, Napa County, California.
Donor: C. Cicero. June, 1936.

20677 METACINNABARITE (HgS).
From Ryne Mine, Mt. Diablo Quicksilver Mining Co., Contra Costa County, California.
Donor: Walter W. Bradley. June 17, 1936.

20678 CINNABAR (HgS) Mercury Sulphide.
From Ryne Mine, Mt. Diablo Quicksilver Mining Co., Contra Costa County, California.
Donor: Walter W. Bradley. June 17, 1936.

20679 JOAQUINITE—Titano-silicate of calcium and iron, associated with Benitoite and Neptunite in Natrolite.
From Headwaters of the San Benito River, San Benito County. California.
Donor: W. C. Eyles. June 17, 1936.

20680 VOLCANIC ASH.
From Gray Eagle Mine, near Creston, San Luis Obispo County, California.
Donor: M. L. Francis. June 24, 1936.

20681 COAL.
From M Coal Mine near San Benito, San Benito County, California. June 26, 1936.

20682 CLAY
From M Coal Mine near San Benito, San Benito County, California. June 26, 1936.

20683 ASBESTOS in serpentine.
From Johns-Manville, Quebec, Canada. July 1, 1936.

20684 GEODE with Calcite and Quartz Crystal center.
From Warsaw, Illinois.
Donor: W. C. Day. July 21, 1936.

20685 CALCITE.
From Saline Valley, Inyo County, California.
Donor: Robert Walsh. July 24, 1936.

20686 BERYL, with Flourite.
From 3 miles west of Lone Pine, Inyo County, California.
Donor: G. J. Sielaff. July 24, 1936.

20687 HEMATITE (Fe_2O_3).
From Isle of Elba, France. July 24, 1936.

20688 TIN ORE.
From Lanpur, State of Perak, Federated Malay States.
Donor: H. A. Kirkpatrick. July 29, 1936.

20689 "PRECIOUS" SERPENTINE.
From Scott Ranch, Sonoma County, California, near The Geysers.
Donor: Dr. Geo. D. Scott. June, 1936.

20690 MOLYBDENITE.
From Caliente, Kern County, California.
Donor: Chas. B. Knox. July 29, 1936.

20691 GOLD ORE
From Alpine Mine, Alpine County, California.
Donor: H. W. Curtz. July 29, 1936.

20692 GOLD ORE. Free gold with associated Argentite (Ag_2S) in quartz and andesite breccia.
From Taio Gold Mine, Kyushu Island, Japan.
Donor: A. Wada. July 30, 1936.

LABORATORY

FRANK SANBORN, Mineral Technologist

A practical application of mineral fluorescence that is now used in a number of mines, and also in the laboratory of the Division of Mines, is one that might be used by the prospector in determining the presence of scheelite, and in making a rough estimate of the scheelite content in a deposit known to contain this valuable ore of tungsten. Scheelite gives off a bluish color in the presence of ultra-violet light. This color is characteristic, and after a little experience with it, a person can tell if a mineral is scheelite, or whether a rock or its concentrates contain any scheelite by simply holding the material under an ultra-violet lamp.

In the laboratory of the Division of Mines scheelite is first detected in a submitted sample by chemical means and then its presence is checked by means of the ultra-violet lamp which also makes it possible for one to estimate roughly the amount of scheelite in the sample.

This procedure should be of interest to prospectors, for we can visualize in the near future prospectors using the ultra-violet ray in searching for scheelite and possibly other valuable minerals. There are several portable models of this lamp on the market and they can be carried by the prospector on his trips. Lamps of this type can be connected to a convenient source of electrical current and with them the prospector can tell rapidly and easily whether he has located scheelite or not. Such work is best done at night, or in the darkness of a hood when the fluorescence of scheelite under ultra-violet light is particularly striking. The operator should shield his eyes from ultra-violet rays when he is using them otherwise an inflammation of the eyes may result.

All garnet-bearing rock should be tested for the presence of scheelite; it also occurs in quartz and other formations. Scheelite practically always concentrates easily in panning as a white concentrate. All white concentrates obtained in panning should be identified, for the white carbonate of lead, cerussite, is not an uncommon mineral, and cerussite often contains silver and gold.

One out of about every six hundred samples received at this laboratory contains a little scheelite. It would be advisable for the ten or twelve people we notify each year that their sample contains scheelite, to investigate the fluorescent properties of this mineral and the use of the ultra-violet lamp in developing their property. The Division of Mines will give information and demonstrations to those who have deposits containing this tungstate of calcium.

LIBRARY

Herbert A. Franke, Librarian

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines contains over six thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, California Journal of Mines and Geology contains under this heading a list of all books and official reports and bulletins received which pertain particularly to mining in California.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the State are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED WHICH HAVE ESPECIAL INTEREST OR REFERENCE TO CALIFORNIA

Governmental, National.

U. S. Geological Survey:

Topographic Sheets:

California:

- Antelope Plain Quadrangle.
- Bell Quadrangle.
- Del Sur Quadrangle.
- Dudley Ridge Quadrangle.
- El Rito Ranch Quadrangle.
- La Panza Quadrangle.
- North of Oildale Quadrangle.
- Red Mountain Quadrangle.
- White River Quadrangle.

U. S. Bureau of Mines:

Bulletin No. 391—Microscopic Structure and Concentratability of the Important Iron Ores of the United States.

Mineral Trade Notes:

Report of Investigations:

3301—Check Determinations of Grindability of Coal by Various Methods. By W. A. Selvig.
3302—Microcolorimetric Determination of Benzene in Blood and Urine. By S. J. Pearce, H. H. Schrenk, and W. P. Yant.

Information Circulars:

6883—Patents on Geophysical Prospecting issued in the United States, England, Canada, Australia, Germany, France and Russia. By Ayvazoglou.
6884—Lime, By Oliver Bowles and D. M. Banks.
6885—Mining & Grinding Methods & Costs at the Claycraft Co. Shale Pit, Taylor Station, Columbus, Ohio. By E. J. Lintner.

U. S. Bureau of Foreign and Domestic Commerce:

Publications:

Monthly Summary of Foreign Commerce of the United States.

PUBLICATIONS RECEIVED CURRENTLY AND FORMER REPORTS AVAILABLE FOR REFERENCE

Governmental, National.

U. S. Geological Survey:

Bulletins, Water-Supply Papers, Annual Reports, Professional Papers, Circulars, Monographs, Topographic Maps, and Special Publications.

U. S. Bureau of Mines:

Bulletins, Technical Papers, Economic Papers, Reports of Investigations, Information Circulars and Miners' Circulars.

Governmental, State.

Alabama Geological Survey, University.
Arizona Bureau of Mines, Tucson.
Arkansas Geological Survey, Little Rock.
Colorado Bureau of Mines, Denver.
Connecticut Geological and Natural History Survey, Hartford.
Florida Department of Conservation, Tallahassee.
Georgia Division of Geology, Atlanta.
Idaho Bureau of Mines and Geology, Moscow.
Illinois Geological Survey, Urbana.
Iowa Geological Survey, Des Moines.
State Geological Survey of Kansas, Lawrence.
Kentucky Geological Survey, Frankfort.
Louisiana Department of Conservation, New Orleans.
Maine State Geologist, Augusta.
Maryland Geological Survey, Baltimore.
Michigan Geological Survey, Lansing.
Minnesota Geological Survey, Minneapolis.
Mississippi State Geological Survey, University.
Missouri Bureau of Geology & Mines, Rolla.
Montana Bureau of Mines and Geology, Butte.
Nebraska Geological Survey, Lincoln.
Nevada State Bureau of Mines, Reno.
New Jersey Department of Conservation and Development, Trenton.
New Mexico Bureau of Mines and Mineral Resources, Socorro.
North Carolina Geological & Economic Survey, Chapel Hill.
North Dakota Geological Survey, Grand Forks.
Ohio Geological Survey, Columbus.
Oklahoma Geological Survey, Norman.
Oregon Bureau of Mines and Geology, Corvallis.

Pennsylvania Topographic and Geological Survey, Harrisburg.
South Dakota State Geological Survey, Vermillion.
Tennessee Division of Geology, Nashville.
Texas Bureau of Economic Geology, Austin.
Virginia Geological Survey, Uinversity.
Washington State Department of Conservation and Development, Pullman.
West Virginia Geological Survey, Morgantown.
Wisconsin Geological & Natural History Survey, Madison.
Wyoming Geological Survey, Cheyenne.

Governmental, Foreign.

Alberta Research Council, Edmonton.
Argentina Direccion General de Minas y Geologica, Buenos Aires.
British Columbia Minister of Mines, Victoria.
British Museum and Natural History, London.
Canada Department of Mines, Ottawa.
Cuerpo de Ingenieros de Minas y Aguas del Peru, Lima.
Geological Service of Minas Geraes, Bella Horizonte, Brazil.
Geological Survey of Scotland.
Instituto Historica e Geographico Rio de Janeiro.
Museo de Historia Natural de Montevideo, Uruguay.
New South Wales Department of Mines, Sydney, Australia.
New Zealand Geological Survey Branch, Wellington.
Nova Scotia Department of Public Works and Mines, Halifax.
Ontario Department of Mines, Toronto, Canada.
Quebec Bureau of Mines, Quebec.
Queensland Department of Mines, Brisbane, Australia.
South Australia Department of Mines, Adelaide.
Transvaal Chamber of Mines, Johannesburg, South Africa.
Western Australia, Geological Survey, Perth.

Societies and Educational Institutions.

Academia de Ciencias y Artes de Barcelona, Spain.
Academy of Natural Sciences, of Philadelphia.
American Association of Petroleum Geologists, Tulsa, Oklahoma.
American Geographical Society of New York.
American Institute of Mining and Metallurgical Engineers. New York.
American Journal of Science, New Haven, Conn.
American Philosophical Society, Philadelphia.
Australian Museum, Sydney.
California Academy of Sciences, San Francisco.
Canadian Institute of Mining and Metallurgy, Montreal.
Carnegie Institution of Washington.
Cleveland Museum of Natural History, Cleveland, Ohio.
Colorado College Publications, Colorado Springs.
Colorado Scientific Society, Denver.
Commonwealth Club, San Francisco.
Economic Geology, Lancaster, Pa.
Field Museum of Natural History, Chicago.
Franklin Institute of the State of Pennsylvania, Lancaster.
Geological Society of America, Columbia University, New York.
Geographical Society of London.
Institution of Mining and Metallurgy, London.
Instituto Geologico de Mexico, Mexico, D. F.
Journal of Geology, Chicago.
Mineralogical Society of America, Menasha, Wisconsin.
Michigan College of Mining and Technology, Houghton.
Mining and Metallurgical Society of America, New York.
Museu Nacional, Rio de Janeiro.
National Research Council, Washington, D. C.
New York Academy of Sciences, New York.
New York State Museum, Albany.
Pennsylvania State College, State College.

Philippine Journal of Science, Manila.
Royal Society of South Australia, Adelaide.
Seismological Society of America, Stanford University.
Sierra Club, San Francisco.
Society of Economical Paleontologists and Mineralogists, Fort Worth, Texas.
Southern California Academy of Sciences, Los Angeles.
University of California Publications in Engineering, Berkeley.
University of California Publications in Geography, Berkeley.
University of California Publications in Geology, Berkeley.
University of Harvard, Department of Mineralogy and Petrography, Cambridge, Mass.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
California Journal of Development, San Francisco.
California Mining Journal, Auburn.
California Oil World, Los Angeles.
California Safety News, San Francisco.
Canadian Mining Journal, Gardenvale, Quebec.
Chemical and Metallurgical Engineering, New York City.
Chemical Engineering and Mining Review, Melbourne, Australia.
Colorado School of Mines, Golden, Colorado.
Engineering and Mining Journal, New York City.
Fuel Oil, Chicago, Illinois.
Fusion Facts, Whittier, California.
Gold, Toronto, Canada.
Grizzly Bear, Los Angeles.
Hercules Mixer, Wilmington, Delaware.
Lubrication, The Texas Co., New York City.
Metals and Alloys, Pittsburg, Pennsylvania.
Mineralogist, Portland, Oregon.
Mining Congress Journal, Washington, D. C.
Mining and Industrial News, San Francisco.
Mining Journal, London.
Mining Journal, Phoenix, Arizona.
Mining and Metallurgy, New York City.
Mining Review, Salt Lake City.
Nickel Cast Iron News, New York City.
Northwest Science, Moscow, Idaho.
Northwest Mining, Spokane, Washington.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York City.
Oil Weekly, Houston, Texas.
Pacific Purchaser, San Francisco.
Petroleum World, Los Angeles.
Pit and Quarry, Chicago.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago.
Rocks and Minerals, Peekskill, New York.
Scientific American, New York City.
Southwest Builder and Contractor, Los Angeles.
Stabilizer, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York City.
Western Mining News, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Alaska Weekly, Seattle, Washington.
Amador Dispatch, Jackson, California.

Banner, Sonora, California.
Barstow Printer, Barstow, California.
Bridgeport Chronicle-Union, Bridgeport, California.
Calaveras Californian, Angels Camp, California.
Calaveras Prospect, San Andreas, California.
Colusa Sun-Herald, Colusa, California.
Daily Commercial News, San Francisco, California.
Daily Midway Driller, Taft, California.
Del Norte Triplicate, Crescent City, California.
Denver Mining Record, Denver, Colorado.
Georgetown Gazette, Georgetown, California.
Inyo Independent, Independence, California.
Inyo Register, Bishop, California.
Las Vegas Age, Las Vegas, Nevada.
Livermore Herald, Livermore, California.
Los Angeles Times, Los Angeles, California.
Mariposa Gazette, Mariposa, California.
Mercury Register, Oroville, California.
Mohave Miner, Kingman, Arizona.
Mojave-Randsburg Record, Mojave, California.
Morning Union, Grass Valley, California.
Mountain Messenger, Downieville, California.
Needles Nugget, Needles, California.
Nevada City Nugget, Nevada City, California.
Nevada Mining Bulletin, Las Vegas, Nevada.
Oil Marketer, Bayonne, New Jersey.
Placer Herald, Auburn, California.
Plumas Independent, Quincy, California.
San Diego News, San Diego, California.
Shasta Courier, Redding, California.
Siskiyou News, Yreka, California.
Stockton Record, Stockton, California.
Tehachapi News, Tehachapi, California.
Terra Bella News, Terra Bella, California.
Tuolumne Independent, Sonora, California.
Tuolumne Prospector, Tuolumne, California.
Union Democrat, Sonora, California.
Ventura County News, Ventura, California.
Waterford News, Waterford, California.
Weekly Trinity Journal, Weaverville, California.
Western Mineral Survey, Salt Lake City, Utah.
Western Sentinel, Etna Mills, California.

PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by this Division to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of *Mining in California* was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of CALIFORNIA JOURNAL OF MINES AND GEOLOGY, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes,' and sent to those on the mailing list of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.

PUBLICATIONS OF THE DIVISION OF MINES

During the past fifty-six years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the State, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have usually been limited, the reports and bulletins mentioned are printed in limited editions many of which are now entirely exhausted.

Copies of such publications are available for reference, however, in the offices of the Division of Mines, in the Ferry Building, San Francisco; State Building, Los Angeles; State Office Building, Sacramento; Redding; and Division of Oil and Gas at Santa Barbara, Taft, Bakersfield, Coalinga. They may also be found in many public, private and technical libraries in California and other states and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

Money orders should be made payable to the Division of Mines.

Purchasers in California add 3 per cent sales tax.

NOTE.—The Division of Mines frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

Asterisks (**) indicate the publication is out of print.

	Price[a]	Shipping Charges
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----	----
Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	$0.50	$0.10
Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	.50	.10
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----	----
Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	1.00	.15
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	1.00	.20
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:		
Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	.50	.10
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50	.10
Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	.25	.10
Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pp., paper	.50	.10
Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	.35	.10
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915: A General Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:		
Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	.65	.10
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	.50	.05
Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper	.65	.10
Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper	.65	.10
Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	.50	.10
Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	.65	.10

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[a] Purchasers in California, add 3 per cent sales tax.

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917: A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1917-1918, Fletcher Hamilton:		
Mines and Mineral Resources of Nevada County, 270 pp., paper	$0.75	$0.15
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50	.10
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50	.10
Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75	.25
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:		
**January, **February, March, April, May, June, July, August, September, October, **November, December, 1922	.25	.05
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	.25	.05
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, **July, October, 1924, per copy	.25	.05
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties	.25	.05
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties	.25	.05
July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.25	.10
**October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties	----	----
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
**January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties	----	----
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial Counties	.25	.10
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties	.25	.05
**October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	----	----
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island	.25	.10
April, 1927, Mines and Mineral Resources of Amador and Solano Counties	.25	.05
**July, 1927, Mines and Mineral Resources of Placer and Los Angeles Counties	----	----
October, 1927, Mines and Mineral Resources of Mono County	.25	.05
Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1928, Mines and Mineral Resources of Tuolumne County	.25	.05
April, 1928, Mines and Mineral Resources of Mariposa County	.25	.05
July, 1928, Mines and Mineral Resources of Butte and Tehama Counties	.25	.05
October, 1928, Mines and Mineral Resources of Plumas and Madera Counties	.25	.05
Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
**January, 1929, Mines and Mineral Resources of Lassen, Modoc and Kern Counties; also on Special Placer Machines	----	----

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
April, 1929, Mines and Mineral Resources of Sierra, Napa, San Francisco and San Mateo Counties	$0.25	$0.10
July, 1929, Mines and Mineral Resources of Colusa, Fresno and Lake Counties	.25	.10
October, 1929, Mines and Mineral Resources of Glenn, Alameda, Mendocino and Riverside Counties	.25	.10
Chapters of Twenty-sixth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1930, Mines and Mineral Resources of Santa Clara County; also Barite in California	.25	.05
April, 1930, Mines and Mineral Resources of Nevada County; also Mineral Paint Materials in California	.25	.05
July, 1930, Mines and Mineral Resources of Yuba and San Bernardino Counties; also Commercial Grinding Plants in California	.25	.10
October, 1930, Mines and Mineral Resources of Butte, Kings and Tulare Counties; also Geology of Southwestern Mono County (Preliminary)	.25	.10
Chapters of Twenty-seventh Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1931, Preliminary Report on Economic Geology of the Shasta Quadrangle. Beryllium and Beryl. The New Tariff and Nonmetallic Products. Crystalline Talc. Decorative Effects in Concrete	.25	.10
April, 1931, Stratigraphy of the Kreyenhagen Shale. Diatoms and Silicoflagellates of the Kreyenhagen Shale. Foraminifera of the Kreyenhagen Shale. Geology of Santa Cruz Island	.25	.10
July, 1931. (Yuba, San Bernardino.) Feldspar, Silica, Andalusite and Cyanite Deposits of California. Note on a Deposit of Andalusite in Mono County; its occurrence and chemical importance. Bill creating Trinity and Klamath River Fish and Game District and its effect upon mining	.25	.10
October, 1931. (Alpine.) Geology of the San Jacinto Quadrangle south of San Gorgonio Pass, California. Notes on Mining Activities in Inyo and Mono Counties in July, 1931	.25	.05
Chapters of Twenty-eighth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1932, Economic Mineral Deposits of the San Jacinto Quadrangle. Geology and Physical Properties of Building Stone from Carmel Valley. Contributions to the Study of Sediments. Sediments of Monterey Bay. Sanbornite	.25	.10
**April, 1932. Elementary Placer Mining Methods and Gold Saving Devices. The Pan, Rocker and Sluice Box. Prospecting for Vein Deposits. Bibliography of Placer Mining	----	----
Abstract from April quarterly: Elementary Placer Mining Methods and Gold Saving Devices. Types of Deposits, Simple Equipment. Special Machines. Dry Washing. Black Sand Treatment. Marketing of Products. Placer Mining Areas. Laws. Prospecting for Quartz Veins. Bibliography (mimeographed)	.20	.05
July-October. (Ventura.) Report accompanying Geologic Map of Northern Sierra Nevada. Fossil Plants in Auriferous Gravels of the Sierra Nevada. Glacial and Associated Stream Deposits of the Sierra Nevada. Jurassic and Cretaceous Divisions in the Knoxville-Shasta Succession of California. Geology of a Part of the Panamint Range. Economic Report of a Part of the Panamint Range. Acquiring Mining Claims Through Tax Title. The Biennial Report of State Mineralogist	.50	.15
Chapters of Report XXIX, 1933 (quarterly: titled "California Journal of Mines and Geology," containing the following:		
January-April. Gold Deposits of the Redding and Weaverville Quadrangles. Geologic Formations of the Redding-Weaverville District, Northern California. Geology of Portions of Del Norte and Siskiyou Counties. Applications of Geology to Civil Engineering. The Lakes of California. Discovery of Piedmontite in the Sierra Nevada. Tracing		

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
'Buried River' Channel Deposits by Geomagnetic Methods. Geologic Map of Redding-Weaverville District, showing gold mines and prospects. Geologic Map showing various mines and prospects of part of Del Norte and Siskiyou Counties	$0.80	$0.15
July-October. Gold Resources of Kern County. Limestone Deposits of the San Francisco Region. Limestone Weathering and Plant Associations of the San Francisco Region. Booming. Death Valley National Monument, California. Placer Mining Districts, Senate Bill 480. Navigable Waters, Assembly Bill 1543	.80	.10
Chapters of Report XXX, 1934 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
January. Resurrection of Early Surfaces in the Sierra Nevada. Geology and Mineral Resources of Northeastern Madera County. Geology and Mineral Deposits of Laurel and Convict Basins, Southwestern Mono County. Notes on Sampling as Applied to Gold Quartz Deposits	.40	.10
April-July. Elementary Placer Mining in California and Notes on the Milling of Gold Ores	.80	.10
October. Current Mining Developments in Northern California. Current Mining Activity in Southern California. Geology and Mineral Resources of the Julian District, San Diego County. Geology and Mineral Resources of Elizabeth Lake Quadrangle. Dry Placers of Northern Mojave Desert. Biennial Report of State Mineralogist. Assessment Work Within Withdrawn Areas	.40	.10
Chapters of Report XXXI, 1935 (quarterly): titled "California Journal of Mines and Geology"		
January. Review of Gold Mining in East-Central, 1934. Current Mining Activities in the San Francisco District with Special Reference to Gold. Geological Investigation of the Clays of Riverside and Orange Counties Southern California. Information regarding Mining Loans by the Reconstruction Finance Corporation	.40	.10
April. A Geologic Section Across the Southern Peninsular Range of California. New Technique Applicable to the Study of Placers. Grubstake Permits	.40	.10
July. Mines and Mineral Resources of Siskiyou County (with map). Dams for Hydraulic Mining Debris. Leasing System as Applied to Metal Mining. Mine Financing in California. New Laws Make Radical Change in Mining Rights	.40	.10
October. Mines and Mineral Resources of San Luis Obispo County. Mineral Resources of Portions of Monterey and Kings Counties. Mining Activity at Soledad Mountain and Middle Buttes—Mojave District, Kern County. Geology of a Portion of the Perris Block, Southern California. Mineral Resources of a Portion of the Perris Block, Riverside County	.40	.10
Chapters of Report XXXII, 1936 (quarterly): titled "California Journal of Mines and Geology," January. Gold Mines of Placer County, including Drag-line Dredges. Geologic report on Borax Lake, California	.40	.10
April. Geology, Mining and Processing of Diatomite at Lompoc, Santa Barbara County. Essentials in Developing and Financing a Prospect into a Mine. Gold-bearing Veins of Meadow Lake District, Nevada County. Semi-Precious Gem Stone Collection in Division Museum	.40	.10
Subscription, $1.75 postpaid in advance (by calendar year, only).		
Chapters of State Oil and Gas Supervisor's Report:		
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free	----
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:		
**April, **May, **June, **July, **August, **September, **October, **November, **December, 1919	----	---
**January, **February, **March, **April, **May, **June, **July, **August, **September, **October, **November, **December, 1920	----	---

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
January, **February, **March, April, **May, **June, **July, August, **September, **October, **November, **December, 1921	Free	----
January, February, March, April, May, June, **July, **August, September, **October, **November, December, 1922	Free	----
January, February, **March, **April, May, **June, **July, August, September, **October, November, **December, 1923	Free	----
January, February, March, April, May, June, **July, August, September, October, November, December, 1924	Free	----
January, February, March, April, May, June, July, August, September, October, November, December, 1925	Free	----
January, February, March, April, May, June, July, August, September, October, November, December, 1926	Free	----
January, February, March, April, May, June, July, August, September, October, November, December, 1927	Free	----
January, February, March, April, **May, June, July, August, September, October, **November, **December, 1928	Free	----
January, February, March, April, May, June, July-August-September, October-November-December, 1929	Free	----
(Published quarterly beginning July, 1929.)		
January-February-March, April-May-June, July-August-September, October-November-December, 1930	Free	----
January-February-March, April-May-June, July-August-September, 1931	Free	----
January, February, March, April, May, June, July, August, September, October, November, December, 1932	Free	----
January, February, March, 1933	Free	----
April, May, June, 1933	Free	----
July, August, September, 1933	Free	----

BULLETINS

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----	----
**Bulletin No. 4. Catalogue of Californian Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887)	----	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----	----
**Bulletin No. 6. California Gold Mill Practices, 1895, by E. B. Preston, 85 pp., 46 illustrations	----	----
**Bulletin No. 7. Mineral Production of California, by Counties, for the year 1894, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 8. Mineral Production of California, by Counties, for the year 1895, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 9. Mine Drainage, Pumps, etc., by Hans C. Behr. 1896, 210 pp., 206 illustrations	----	----
**Bulletin No. 10. A bibliography Relating to the Geology, Paleontology and Mineral Resources of California, by Anthony W. Vogdes. 1896, 121 pp.	----	----
**Bulletin No. 11. Oil and Gas Yielding Formations of Los Angeles, Ventura and Santa Barbara Counties, by W. L. Watts. 1897, 94 pp., 6 maps, 31 illustrations	----	----
**Bulletin No. 12. Mineral Production of California, by Counties, for 1896, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 13. Mineral Production of California, by Counties, for 1897, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 14. Mineral Production of California, by Counties, for 1898, by Charles G. Yale	----	----
**Bulletin No. 15. Map of Oil City Fields, Fresno County, by John H. Means, 1899	----	----
**Bulletin No. 16. The Genesis of Petroleum and Asphaltum in California, by A. S. Cooper. 1899, 39 pp., 29 illustrations	----	----
**Bulletin No. 17. Mineral Production of California, by Counties, for 1899, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 18. Mother Lode Region of California, by W. H. Storms. 1900, 154 pp., 49 illustrations	----	----
**Bulletin No. 19. Oil and Gas Yielding Formations of California, by W. L. Watts. 1900, 236 pp., 60 illustrations, 8 maps	----	----
**Bulletin No. 20. Synopsis of General Report of State Mining Bureau, by W. L. Watts. 1901, 21 pp. This bulletin contains a brief statement of the progress of the mineral industry in California for the four years ending December, 1899	----	----
**Bulletin No. 21. Mineral Production of California by Counties, by Charles G. Yale. 1900. Tabulated sheet	----	----
**Bulletin No. 22. Mineral Production of California for Fourteen Years, by Charles G. Yale. 1900. Tabulated sheet	----	----
**Bulletin No. 23. The Copper Resources of California, by P. C. DuBois, F. M. Anderson, J. H. Tibbits and G. A. Tweedy. 1902, 282 pp., 69 illustrations, 9 maps	----	----
**Bulletin No. 24. The Saline Deposits of California, by G. E. Bailey. 1902, 216 pp., 99 illustrations, 5 maps	----	----
**Bulletin No. 25. Mineral Production of California, by Counties, for 1901, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 26. Mineral Production of California for the Past Fifteen Years, by Charles G. Yale. 1902. Tabulated sheet	----	----
**Bulletin No. 27. The Quicksilver Resources of California, by William Forstner. 1903, 273 pp., 144 illustrations, 8 maps	----	----

BULLETINS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**Bulletin No. 28. Mineral Production of California for 1902, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 29. Mineral Production of California for Sixteen Years, by Charles G. Yale. 1903. Tabulated sheet	----	----
**Bulletin No. 30. Bibliography Relating to the Geology, Paleontology and Mineral Resources of California, by A. W. Vogdes. 1903, 290 pp.	----	----
**Bulletin No. 31. Chemical Analyses of California Petroleum, by H. N. Cooper. 1904. Tabulated sheet	----	----
**Bulletin No. 32. Production and Use of Petroleum in California, by Paul W. Prutzman. 1904, 230 pp., 116 illustrations, 14 maps	----	----
**Bulletin No. 33. Mineral Production of California, by Counties, for 1903, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 34. Mineral Production of California for Seventeen Years, by Charles G. Yale. 1904. Tabulated sheet	----	----
**Bulletin No. 35. Mines and Minerals of California, by Charles G. Yale. 1904, 55 pp., 20 county maps. Relief map of California	----	----
**Bulletin No. 36. Gold Dredging in California, by J. E. Doolittle. 1905. 120 pp., 66 illustrations, 3 maps	----	----
**Bulletin No. 37. Gems, Jewelers' Materials, and Ornamental Stones of California, by George F. Kunz. 1905, 168 pp., 54 illustrations	----	----
**Bulletin No. 38. Structural and Industrial Materials of California, by Wm. Forstner, T. C. Hopkins, C. Naramore and L. H. Eddy. 1906, 412 pp., 150 illustrations, 1 map	----	----
**Bulletin No. 39. Mineral Production of California, by Counties, for 1904, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 40. Mineral Production of California for Eighteen Years, by Charles G. Yale. 1905. Tabulated sheet	----	----
**Bulletin No. 41. Mines and Minerals of California for 1904, by Charles G. Yale. 1905, 54 pp., 20 county maps	----	----
**Bulletin No. 42. Mineral Production of California, by Counties, 1905, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 43. Mineral Production of California for Nineteen Years, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 44. California Mines and Minerals for 1905, by Charles G. Yale. 1907, 31 pp., 20 county maps	----	----
**Bulletin No. 45. Auriferous Black Sands of California, by J. A. Edman. 1907. 10 pp.	----	----
**Bulletin No. 46. General Index of Publications of the California State Mining Bureau, by Charles G. Yale. 1907, 54 pp.	----	----
**Bulletin No. 47. Mineral Production of California, by Counties, 1906, by Charles G. Yale. Tabulated sheet	----	----
**Bulletin No. 48. Mineral Production of California for Twenty Years, by Charles G. Yale. 1906	----	----
**Bulletin No. 49. Mines and Minerals of California for 1906, by Charles G. Yale. 34 pp.	----	----
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**Bulletin No. 51. Mineral Production of California, by Counties, 1907, by D. H. Walker. Tabulated sheet	----	----
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**Bulletin No. 70. Mineral Production for 1914, with County Maps and Mining Laws. 184 pp.	----	----
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†Bulletin No. 80. Tungsten, Molybdenum and Vanadium in California. (In preparation.)		
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PRELIMINARY REPORTS

**Preliminary Report No. 1. Notes on Damage by Water in California Oil Fields, December, 1913. By R. P. McLaughlin, 4 pp.	----	----
**Preliminary Report No. 2. Notes on Damage by Water in California Oil Fields, March, 1914. By R. P. McLaughlin, 4 pp.	----	----
Preliminary Report No. 3. Manganese and Chromium, 1917. By E. S. Boalich. 32 pp.	Free	.05
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Preliminary Report No. 5. Antimony, Graphite, Nickel, Potash, Strontium and Tin. By E. S. Boalich and W. O. Castello, 1918. 44 pp. Paper	Free	.05
**Preliminary Report No. 6. A Review of Mining in California During 1919. By Fletcher Hamilton, 1920. 43 pp. Paper	----	----
**Preliminary Report No. 7. The Clay Industry in California. By E. S. Boalich, W. O. Castello, E. Huguenin, C. A. Logan, and W. B. Tucker, 1920. 102 pp. 24 illustrations. Paper	----	----
**Preliminary Report No. 8. A Review of Mining in California During 1921, with Notes on the Outlook for 1922. By Fletcher Hamilton, 1922. 68 pp. Paper	----	----

MISCELLANEOUS PUBLICATIONS

**First Annual Catalogue of the State Museum of California, being the collection made by the State Mining Bureau during the year ending April 16, 1881. 350 pp.	----	----
**Catalogue of books, maps, lithographs, photographs, etc., in the library of the State Mining Bureau at San Francisco, May 15, 1884. 19 pp.	----	----
**Catalogue of the State Museum of California, Volume II, being the collection made by the State Mining Bureau from April 16, 1881, to May 5, 1884. 220 pp.	----	----
**Catalogue of the State Museum of California, Volume III, being the collection made by the State Mining Bureau from May 15, 1884, to March 31, 1887. 195 pp.	----	----
**Catalogue of the State Museum of California, Volume IV, being the collection made by the State Mining Bureau from March 30, 1887, to August 20, 1890. 261 pp.	----	----
**Catalogue of the Library of the California State Mining Bureau, September 1, 1892. 149 pp.	----	----
**Catalogue of West North American and Many Foreign Shells with Their Geographical Ranges, by J. G. Cooper. Printed for the State Mining Bureau, April, 1894	----	----
**Report of the Board of Trustees for the four years ending September, 1900. 15 pp. Paper	----	----
Bulletin. Reconnaissance of the Colorado Desert Mining District. By Stephen Bowers, 1901. 19 pp. 2 illustrations. Paper	.10	----
Commercial Mineral Notes. A monthly mimeographed sheet, beginning April, 1923	Free	.15 annually

MAPS

Register of Mines With Maps

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	Price	Shipping Charges
**Register of Mines, with Map, Amador County	----	----
Register of Mines, with Map, Butte County	$0.25	$0.05
**Register of Mines, with Map, Calaveras County	----	----
**Register of Mines, with Map, El Dorado County	----	----
**Register of Mines, with Map, Inyo County	----	----
**Register of Mines, with Map, Kern County	----	----
**Register of Mines, with Map, Lake County	----	----
**Register of Mines, with Map, Mariposa County	----	----
**Register of Mines, with Map, Nevada County	----	----
**Register of Mines, with Map, Placer County	----	----
**Register of Mines, with Map, Plumas County	----	----
**Register of Mines, with Map, San Bernadino County	----	----
Register of Mines, with Map, San Diego County	.25	.05
Register of Mines, with Map, Santa Barbara County (1906)	.25	.05
**Register of Mines, with Map, Shasta County	----	----
**Register of Mines, with Map, Sierra County	----	----
**Register of Mines, with Map, Siskiyou County	----	----
**Register of Mines, with Map, Trinity County	----	----
**Register of Mines, with Map, Tuolumne County	----	----
Register of Mines, with Map, Yuba County (1905)	.25	.05
Register of Oil Wells, with Map, Los Angeles City (1906)	.35	.05

OTHER MAPS

	Price	Shipping Charges
**Map of California, Showing Mineral Deposits (50 x 60 in.)	----	----
**Map of Forest Reserves in California	----	----
**Mineral and Relief Map of California	----	----
**Map of El Dorado County, Showing Boundaries, National Forests	----	----
**Map of Madera County, Showing Boundaries, National Forests	----	----
**Map of Placer County, Showing Boundaries, National Forests	----	----
**Map of Shasta County, Showing Boundaries, National Forests	----	----
**Map of Sierra County, Showing Boundaries, National Forests	----	----
**Map of Siskiyou County, Showing Boundaries, National Forests	----	----
**Map of Tuolumne County, Showing Boundaries, National Forests	----	----
**Map of Mother Lode Region	----	----
**Map of Desert Region of Southern California	----	----
Map of Minaret District, Madera County	.20	.05
Map of Copper Deposits in California	.05	----
**Map of Calaveras County	----	----
**Map of Plumas County	----	----
**Map of Trinity County	----	----
**Map of Tuolumne County	----	----
Geological Map of Inyo County. Scale 1 inch equals 4 miles	.60	.05
**Map of California accompanying Bulletin No. 89, showing generalized classification of land with regard to oil possibilities. Map only, without Bulletin	----	----
Geological Map of California, 1916. Scale 1 inch equals 12 miles. As accurate and up-to-date as available data will permit as regards topography and geography. Shows railroads, highways, post offices and other towns. First geological map that has been available since 1892, and shows geology of entire state as no other map does. Geological details lithographed in 23 colors. Unmounted	.75	.05
Mounted	2.50	.15
**Topographic Map of Sierra Nevada Gold Belt, showing distribution of auriferous gravels, accompanying Bulletin No. 92. In 4 colors (also sold singly)	----	----

OTHER MAPS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
Geologic Map of Northern Sierra Nevada, showing Tertiary River Channels and Mother Lode Belt, accompanying July-October Chapter of Report XXVIII of the State Mineralogist. (Sold singly)	$0.25	$0.05
Map of Northern California, showing rivers and creeks which produced placer gold in 1932	.20	.05
Mother Lode Geologic and claim maps in 5 county sections: El Dorado, Amador, Calaveras, Tuolumne and Mariposa. Single sections 10c. Set of 5	.50	----
Map of Mariposa County showing principal gold mines	.10	----
Geologic Map of Elizabeth Lake Quadrangle, Los Angeles and Kern Counties (accompanying October Chapter of Report XXX), sold separately	.10	----
Map of Western Portion of Siskiyou County Showing Location of Principal Gold Mines (accompanying July Chapter of Report XXXI), sold separately	.10	----

OIL FIELD MAPS

The maps are revised from time to time as development work advances and ownerships change.

	Price (including postage)
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Map No. 2—Santa Maria, including Cat Canyon and Los Alamos	1.00
Map No. 3—Santa Maria, including Casmalia and Lompoc	1.00
Map No. 4—Brea Olinda & (East Portion) Coyote Hills, Los Angeles and Orange Counties	1.00
Map No. 6—Salt Lake-Beverly Hills, Los Angeles County	1.00
Map No. 7—Sunset and San Emidio, Kern County	1.00
Map No. 8—South Midway and Buena Vista Hills, Kern County	1.00
Map No. 9—North Midway and McKittrick, Kern County	1.00
Map No. 10—Belridge and McKittrick Front, Kern County	1.00
Map No. 11—Lost Hills and North Belridge, Kern County	1.00
Map No. 12—Devils Den, Kern County	.75
Map No. 13—Kern River, Kern County	1.00
Map No. 14—Coalinga, Fresno County	1.25
Map No. 15—Elk Hills, Kern County	1.00
Map No. 16—Ventura-Ojai, Ventury County	1.00
Map No. 17—Santa Paula–Sespe, including Bardsdale, South Mountain and Camarillo, Ventura County	1.00
Map No. 18—Piru-Simi-Newhall, Ventura County	1.00
Map No. 19—Arroyo Grande, San Luis Obispo County	.75
Map No. 20—Long Beach, Los Angeles County	1.50
Map No. 21—Portion of District No. 4, showing boundaries of oil fields—Kern and Kings Counties	.75
Map No. 21-A—Portion of District No. 4, showing boundaries of oil fields—Kern County	.75
Map No. 21-B—Portion of District No. 5, showing boundaries of oil fields—Fresno, Kings and Kern Counties	.75
Map No. 22—Portion of District No. 3, showing boundaries of oil fields—Santa Barbara County	.75
Map No. 23—Portion of District No. 2, showing boundaries of oil fields—Ventura County	.75
Map No. 24—Portion of District No. 1, showing boundaries of oil fields—Los Angeles and Orange Counties	1.00
Map No. 26—Huntington Beach, Orange County	1.25
Map No. 27—Santa Fe Springs, Los Angeles County	1.00
Map No. 28—Torrance, Los Angeles County	1.00
Map No. 29—Dominguez, Los Angeles County	.75
Map No. 30—Rosecrans, Los Angeles County	.75
Map No. 31—Inglewood, Los Angeles County	1.00
Map No. 32—Seal Beach, Los Angeles and Orange Counties	1.00

OIL FIELD MAPS—Continued

	Price (including postage)
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Map No. 34—Mt. Poso, Kern County	.75
Map No. 35—Round Mountain, Kern County	.75
Map No. 36—Kettleman Hills, Fresno, Kings and Kern Counties	1.25
Map No. 37—Montebello, Los Angeles County	1.00
Map No. 38—Whittier, Los Angeles County	1.00
Map No. 39—West Coyote, Los Angeles and Orange Counties	1.00
Map No. 40—Elwood, Santa Barbara County	1.00
Map No. 41—Potrero, Los Angeles County	.75
Map No. 42—Playa del Rey, Los Angeles County	1.25
Map No. 43—Capitan, Santa Barbara County	.75
Map No. 44—Mesa, Santa Barbara County	1.25
Map No. 45—Buttonwillow gas, Kern County	.75
Map No. 46—Richfield, Orange County	1.00
Map No. 47—Mountain View, Kern County	.75
Map No. 48—Mountain View and Edison, Kern County	1.25

DETERMINATION OF MINERAL SAMPLES

Samples (limited to two at one time) of any mineral found in the State may be sent to the Division of Mines for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the State. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

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STATE OF CALIFORNIA
DEPARTMENT OF NATURAL RESOURCES
GEORGE D. NORDENHOLT, Director

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO

WALTER W. BRADLEY State Mineralogist

Vol. 32 OCTOBER, 1936 No. 4

CALIFORNIA JOURNAL
OF
MINES AND GEOLOGY

QUARTERLY CHAPTER
OF
STATE MINERALOGIST'S REPORT XXXII

STATE DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO,
CALIFORNIA

38201

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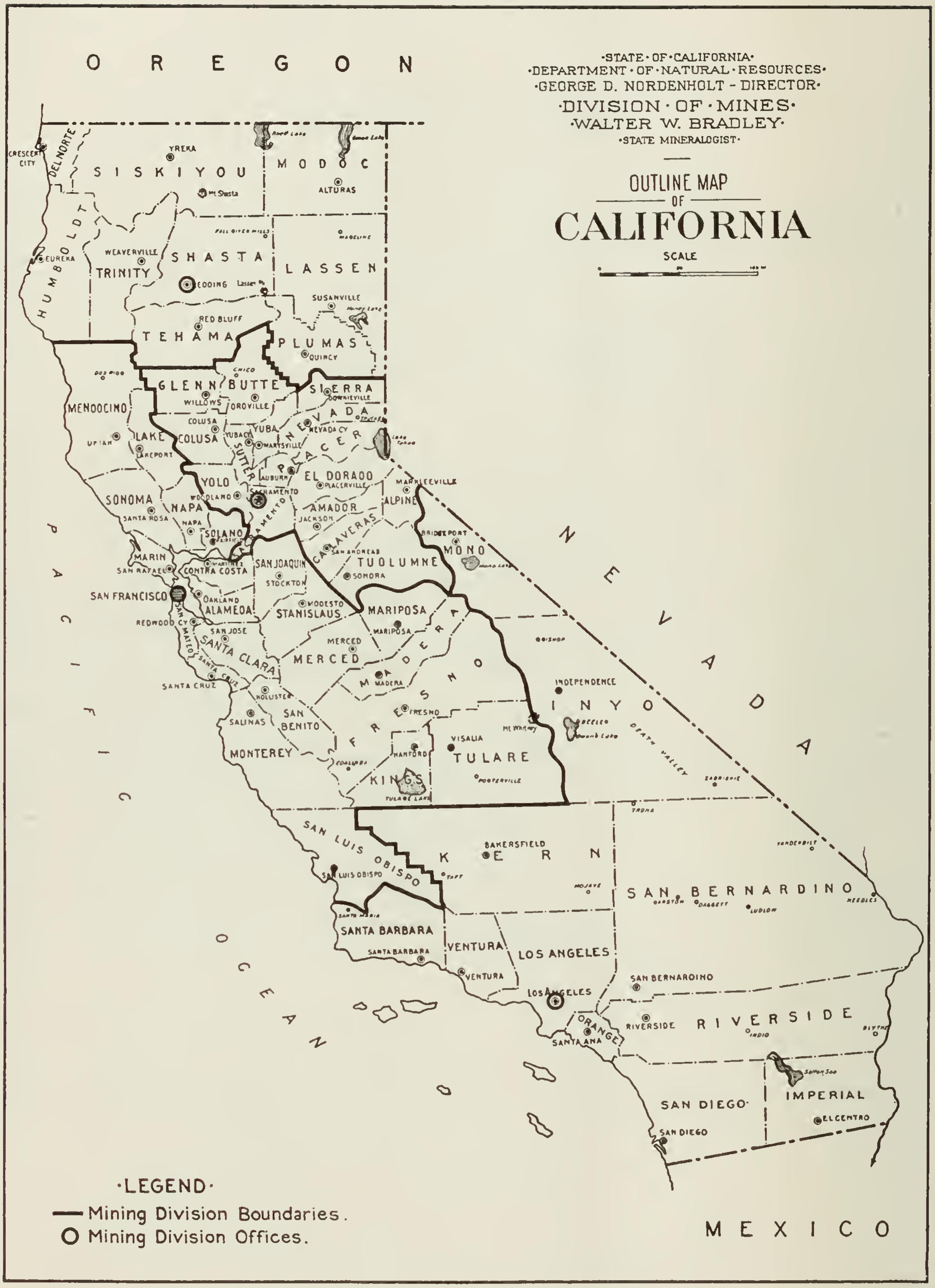
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·DEPARTMENT·OF·NATURAL·RESOURCES·
·GEORGE D. NORDENHOLT - DIRECTOR·
·DIVISION·OF·MINES·
·WALTER W. BRADLEY·
·STATE MINERALOGIST·
OUTLINE MAP
OF
CALIFORNIA
SCALE
OREGON
NEVADA
MEXICO
PACIFIC OCEAN
DEL NORTE
CRESCENT CITY
SISKIYOU
YREKA
Mt. Shasta
MODOC
ALTURAS
HUMBOLDT
EUREKA
TRINITY
WEAVERVILLE
SHASTA
REDDING
LASSEN
SUSANVILLE
TEHAMA
RED BLUFF
PLUMAS
QUINCY
GLENN
WILLOWS
BUTTE
CHICO
OROVILLE
SIERRA
DOWNIEVILLE
MENDOCINO
UKIAH
LAKE
LAKEPORT
COLUSA
YUBA
YUBA CITY
MARYSVILLE
NEVADA
NEVADA CY
PLACER
AUBURN
SUTTER
EL DORADO
PLACERVILLE
YOLO
WOODLAND
SACRAMENTO
SONOMA
SANTA ROSA
NAPA
SOLANO
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MARKLEEVILLE
MARIN
SAN RAFAEL
CONTRA COSTA
MARTINEZ
SAN JOAQUIN
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CALAVERAS
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TUOLUMNE
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MONO
BRIDGEPORT
SAN FRANCISCO
OAKLAND
ALAMEDA
MODESTO
STANISLAUS
MARIPOSA
REDWOOD CY
SAN MATEO
SAN JOSE
SANTA CLARA
MERCED
MADERA
SANTA CRUZ
HOLLISTER
SAN BENITO
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INDEPENDENCE
INYO
Mt. Whitney
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VISALIA
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PORTERVILLE
HANFORD
KINGS
COALINGA
Tulare Lake
TRONA
SAN LUIS OBISPO
KERN
BAKERSFIELD
TAFT
MOJAVE
SAN BERNARDINO
BARSTOW
DAGGETT
LUDLOW
NEEDLES
SANTA MARIA
SANTA BARBARA
VENTURA
LOS ANGELES
ORANGE
SANTA ANA
RIVERSIDE
INDIO
BLYTHE
Salton Sea
SAN DIEGO
IMPERIAL
EL CENTRO
·LEGEND·
Mining Division Boundaries.
Mining Division Offices.

PREFACE

The Division of Mines (formerly State Mining Bureau) is maintained for the purpose of assisting in all possible ways in the development of California's mineral resources.

As one means of offering tangible service to the mining public, the State Mineralogist for many years has issued an annual or a biennial report reviewing in detail the mines and mineral deposits of the various counties.

As a progressive step in advancing the interests of the mineral industry, and as permitting earlier distribution to the public, publication of the Annual Report of the State Mineralogist in the form of monthly chapters was begun in January, 1922, and continued until March, 1923. Owing to a lack of funds for printing this was changed to a quarterly publication, beginning in September, 1923. For the same reason, beginning with the January, 1924, issue, it became necessary to charge a subscription price. This covers approximately the cost of printing.

Pages are numbered consecutively throughout the year and an index to the complete report is included annually in the closing number.

Beginning with the 1930 issues, the activities and progress of the Geologic Branch are recorded also in these quarterly chapters. The important part that geology plays in the economic development of our mineral resources is further recognized in the change of title from *Mining in California* to CALIFORNIA JOURNAL OF MINES AND GEOLOGY, beginning with the January, 1933, chapter.

While current activities of all descriptions are covered in these chapters, the practice of issuing from time to time technical reports on special subjects will be continued as well. A list of such reports now available is appended hereto, and the names of new bulletins will be added in the future as they are completed.

The chapters are subject to revision, correction and improvement. Constructive suggestions from the mining public will be gladly received, and are invited.

The one aim of the Division of Mines is to increase its usefulness and to stimulate the intelligent development of the wonderful, latent resources of the State of California.

Types of Reports

In general the reports presented in these chapters are grouped into three classes:

1. Mines and mineral resources of a given county (describing kind, character, distribution and extent of development).
2. Specific economic and industrial mineral products (listing and describing the resources over the entire State of a given mineral substance, e.g. feldspar).
3. Geological reports on specific areas (recording results and conclusions, with maps, derived from field studies; and tied in with economic possibilities, and developments).

REPORTS OF DISTRICT MINING ENGINEERS

In 1919–1920 the Mining Bureau was organized into four main geographic divisions, with the field work delegated to a mining engineer in each district, working out from field offices that were established in Redding, Auburn, San Francisco and Los Angeles, respectively. This move brought the office into closer personal contact with operators, and it has many advantages over former methods of conducting field work, including lower traveling-expense bills for the Bureau's engineers. In 1923 the Redding and Auburn field offices were consolidated and moved to Sacramento.

The Redding office was reestablished in 1928, and the boundaries of each district adjusted. The counties now included in each of the four divisions and the location of the branch offices are shown on the accompanying outline map of the state. (Frontispiece.)

Reports of mining activities and development in each district, prepared by the District Engineer, will continue to appear under the proper field division heading.

REDDING FIELD DISTRICT

MINERAL RESOURCES OF LASSEN COUNTY

By CHAS. VOLNEY AVERILL, District Mining Engineer
and
HOMER D. ERWIN, Mining Geologist[1]

Geography.

Lassen County is located in the northeastern part of the state just south of Modoc County, which lies in the northeastern corner. The eastern boundary line forms part of the line between Nevada and California. Honey Lake Valley, an important part of Lassen County, was thought by the early settlers to be in the State of Nevada and was put into one of the judicial districts of that state. The resulting dispute was settled by survey of the state line and Lassen County was set off in 1864. The area of the county is 4531 square miles and the population by the 1930 census was 12,589. The two principal towns are Susanville, the county seat, with a population of 4531, and Westwood, which is owned entirely by the Red River Lumber Company. The population of the latter has been put at as high as 6000 persons but it varies greatly with the number of persons on the pay roll of the Red River Lumber Company.

Topography.

High forest-covered mountains, plateaus also covered with forest, and valley lands occupy about equal portions of the total area of the county. Honey Lake Valley, Big Valley and Long Valley are at elevations of about 4000 feet; the other important valley, Madeline Plains, is a little more than 1000 feet higher. The plateaus are at elevations of about 6000 feet, and the mountains reach 7000 and 8000 feet. The southern portion of the county drains into Honey Lake through Susan River, Long Valley Creek and smaller streams; the northern portion drains into Pit River. Honey Lake is a large body of water in the southeastern part of the county, covering 64,000 acres when filled, but it evaporates rapidly during the summer months; and in the summer and fall of recent years it has been dry. Eagle Lake, in the central portion of the county, with an area of 27,813 acres, is 1000 feet higher in elevation than Honey Lake, and is much deeper. A portion of Lassen Volcanic National Park is in Lassen County, but Lassen Peak, the only volcano in the United States that has been active in recent years, is in the part of the park located in Shasta County.

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[1] Homer D. Erwin, Mining Geologist, French Gulch, California, or 2839 Guirado Street, Los Angeles, California, was employed for three months by the Lassen County Board of Supervisors to make the geological maps published herewith and to assist in the preparation of this report.

Climate.

Moderate temperature prevails for the greater part of the year; the days are warm and the nights are cool, and very little rain falls. From the middle of December to the middle of March, the weather is cold and snowstorms are frequent. Precipitation amounts to 11 inches of water annually at Litchfield in the eastern part of Honey Lake Valley, and 20 inches at Susanville. In the mountains it is greater, and falls largely as winter snow.

Industries.

Lumbering, stockraising and farming are the chief industries. The largest lumbering operation is that of the Red River Lumber Company at Westwood. The number of persons on the payroll varies from time to time, but it is said that it has been as great as 4700. Other mills are operated by the Lassen Lumber and Box Company and the Fruit Growers Supply Company at Susanville. Privately owned timberland amounts to 300,000 acres, and National Forest to 277,000 acres in the county. The annual production is 300.000,000 board feet, or about one-quarter of that for the state. In addition to lumber, plyboard and veneer-board are made. The Red River Lumber Company develops 20,000 h.p. of electric power from steam and hydro-electric plants; and sells the power at Susanville and other places in the county.

Large numbers of sheep and cattle feed on the ranges of Lassen County. Some 60,000 acres of land are under irrigation with water from Pit River, Susan River and Eagle Lake. The largest crops are those of hay and alfalfa, but grains are important, and vegetables, berries and deciduous fruits are raised. With the exception of beef and mutton, there is a local market for all of the farm products of the county, because of the large number of persons employed by the lumber mills.

Transportation.

Railroad transportation is furnished by two companies. The Western Pacific has a line crossing the southeastern corner of the county; also a line crossing from south to north through the center of the county and connecting with the line in the Feather River canyon to the south and to the lines of the Great Northern at Bieber, Modoc County, which runs from that place to Klamath Falls, Oregon. The Southern Pacific has a line crossing from north to south along the eastern part of the county and connecting with Reno, Nevada, Alturas in Modoc County, and Lakeview, Oregon. A branch of this line also runs to Klamath Falls, Oregon. The hard-surfaced state highway from Red Bluff to Reno crosses Lassen County, passing through Susanville. Another hard-surfaced highway connects Susanville with Alturas in Modoc County.

Geology and Mineral Deposits.

Tertiary rocks cover all of Lassen County except a strip along the southern border. Undoubtedly, these formations are less favorable to the occurrence of valuable and deep-seated mineral deposits than older formations of the Sierra Nevada; and perhaps on this account, prospecting has been neglected. However, a productive district has been developed in these Tertiary formations at Hayden Hill, and its geology is described in more detail below. A band of older rocks is exposed along the southern border of the county and considerable prospecting has been done in that area, both in the vicinity of Diamond Mountain and farther south. A detailed description of the Diamond Mountain locality is given herewith and some of the prospects farther south are also described.

The total recorded mineral production of the county from 1880 to 1934 (inc.) is shown in the accompanying tabulation.

MINERAL PRODUCTION OF LASSEN COUNTY, 1880-1934

Year	Gold, value	Silver, value	Miscellaneous stone, value	Miscellaneous and unapportioned		
				Amount	Value	Substance
1880	$25,900					
1881	71,000	$1,000				
1882	100,000	20,000				
1883	20,000	5,000				
1884	[1]119,060	341				
1885	15,000	150				
1886	25,812	135				
1887	24,108	304				
1888	50,000	200				
1889	97,503	215				
1890	14,890	300				
1891	3,676					
1892	15,400					
1893						
1894	35,283					
1895	25,000					
1896	40,300					
1897	49,100	850				
1898	37,460	300				
1899	28,898					
1900	19,807	676				
1901	5,900	200				
1902	23,410	244				
1903	91,102	1,203				
1904	116,993	1,515				
1905						
1906	[2]	[2]				
1907	[2]	[2]				
1908	7,284	783				
1909	[3]116,327	[3]1,463			$217,521	Unapportioned, 1900-1909
1910	[4]82,180	[4]972				
1911	[2]	[2]			1,522	Gold and silver.
1912						
1913		2	$2,030			[5]
1914	1,250	4	775			[5]
1915			870			
1916			9,725			
1917			376			
1918			800			
1919			1,100			
1920			7,313		5,000	Other minerals.
1921	39,943	1,234	42,308			
1922	[2]	[2]	9,540		17,877	Brick, gold and silver.
1923	[2]	[2]	7,600		240	Gold and silver.
1924	2,250	44	35,614			
1925	1,130	24	1,250			
1926	67	1	18,995			
1927	531	9	47,885		1,000	Granite curbing.
1928	492	8	73,399	1,550 cu. ft.	2,600	Granite.
1929	168	2	88,328		200	Other minerals.
1930	2,946	23	14,600		525	Other minerals.
1931	241	2			1,600	Other minerals.
1932	460	3	109,105			
1933	8,309	68	35,228		2,094	Copper, granite, lead.
1934	14,689	278	[2]	304 lbs.	24	Copper.
					13,327	Other minerals.
Totals	$1,334,869	$37,553	[2]$506,841		$263,530	

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[1] Lawver, A. M. in 'Production of Precious Metals in U. S.': Report of Director of Mint, 1884, p. 175, 1885.

[2] See under 'Unapportioned.'

[3] Includes Modoc and Colusa Counties' production.

[4] Includes Colusa County production.

[5] Copper production erroneously reported from Lassen County in the years 1913 and 1914, on account of shipping point being Doyle, while producing copper mines were located in Plumas County.

DIAMOND MOUNTAIN DISTRICT

Location and Accessibility.

The Diamond Mountain mining district is located in southern Lassen County near the boundary and is in the SE¼ of Township 29 N., R. 11 E. and the SW¼ of Township 29 N., R. 12 E., M. D. M.

Topographically, the district is situated on the lower north slope of the Sierra Nevada between the head of Golden Run creek and Lassen creek and includes Gold Run valley. Susanville, the county seat, is situated about six miles to the north. This town is reached by rail from the south and by highway from the west and north. It is essentially a lumbering and farming center.

The Diamond Mountain district is reached at present by gravel surfaced roads. The road from Susanville is joined by a road from Janesville to the south. This road runs up the head of Gold Run creek and over the Sierra crest. Thus, the region can be reached from the southwest during part of the year. As a large part of the area surveyed has been logged-off there are a great number of relic road beds that make the more important mineral areas rather accessible.

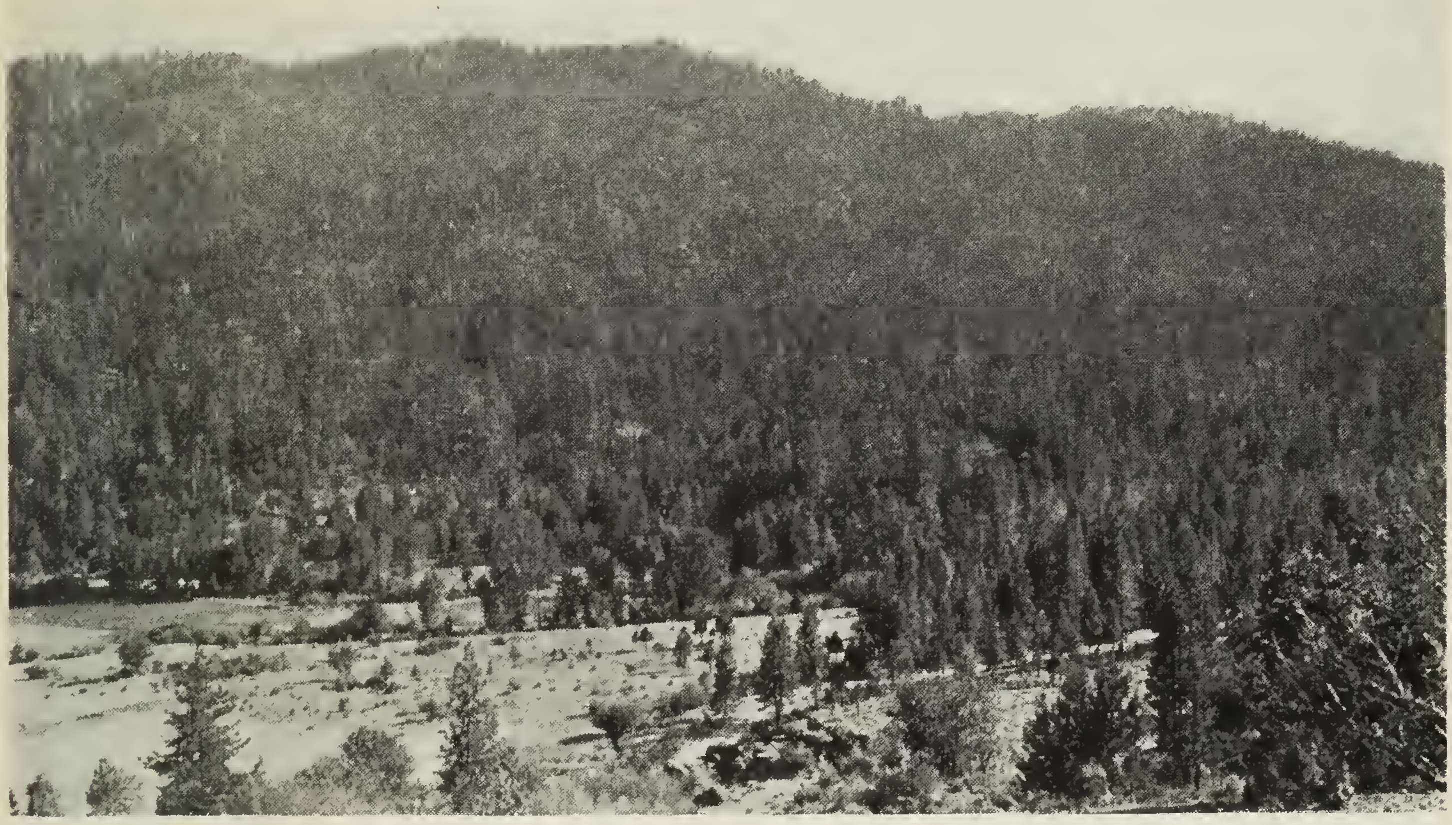

FIG. 1. Portion of Diamond Mountain Mineral Area including McDow, Gayman-Spaulding, and Harris-Musgrove Properties

Purpose and Method of Investigation.

The survey for this report was the result of a longfelt need to obtain accurate and reliable information on various mineral areas in Lassen County. As the Diamond Mountain district has been the least developed of these areas, a systematic geologic survey was instigated on it. Funds for the survey were furnished by Lassen County and the field and office work consumed three months during the summer and fall of 1936.

The survey called for detailed work and as no adequate topographic map was available, plotting was done on township plats. This necessitated the finding and marking of many section and fraction-section corners, together with patented claim corners, for control points. Many intermediate stations were located by compass and pace traverses and by resection.

Overburden is rather thick and covers most of the area investigated, and outcrops are rather poor. Therefore, it was found necessary to use such indicators as the soil, relative density and distribution of rock-float, topographic expression, and vegetation as a guide to mapping geologic features. The location of contacts, shear zones, veins and faults can be associated with springs, growth of water-seeking plants, or certain depressive or other topographic expression. These are valuable guides when supported by additional evidence, but, in most cases, had to be used with much discrimination, especially in the case of vegetation as a guide. The position of the contacts plotted can, therefore, be taken largely as approximate.

Natural vein outcrops are poor or wanting and the location of most veins was established by various surface and underground diggings. The width and nature of those exposed only by surface pits, many of which had filled at the time of the writer's visit, are only approximate or reported.

Previous Work.

Prior to the present investigation, the area had been mapped and described in a very general way. That survey was conducted by J. S. Diller about 1904 and was a reconnaisance of the southern half of the Honey Lake quadrangle together with a more detailed survey of the Taylorsville region.[1] His report does not deal with the possible lode deposits of the region immediately north of Diamond Mountain but deals only with the Tertiary placer deposits there.[2]

Previous to 1912, Waldemar Lindgren investigated Tertiary gravels of the whole Sierra Nevada which included this region.[3]

Historical Sketch.

The only important mining production that the region north of Diamond Mountain has enjoyed in the past has been from early placer operations. Lode-mining to the present time has not been actively pursued and the country is relatively undeveloped in this respect.

Placer operations started with the late fifties when an influx of miners, following after Peter Lassen, found rich placers on Lassen, Hill and Gold Run creeks. These streams supplied much water, and in several years over $200,000 in free gold was obtained. Chinamen followed the early placer miners but were soon forced out by prospective farmers who then began to settle the region.[4]

During the late sixties and early seventies, the region was prospected for lode-mining. The miners, it is said, spread over the country following the discovery of the famous Comstock Lode. They were looking for a bonanza like the Comstock and made many surface openings on the more prominent veins. However, their operations did not develop much, and most of them left the region. This is thought to be due to the fact that coarse gold could not be seen in the rock and so they became disgusted and abandoned the area.

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[1] Diller, J. S. "Geology of the Taylorsville Region, California." U. S. Geo. Sur. Bul. 353 (1908).

[2] Diller, J. S., *op. cit.* pp. 68–70.

[3] Lindgren, Waldemar, "Tertiary Gravels of the Sierra Nevada, California; U. S. Geol. Survey Prof. Paper 110 (1912).

[4] Notes on the history of early placer operations in the Diamond Mountain area as well as elsewhere in Lassen County are given in Fairfield's "History of Lassen County."

A few miners remained, however, and at an early period the district is known to have produced lode gold. At least four properties have mine workings that indicate some appreciable stoping of ore. Nothing is known of these operations but the grade of ore must have been sufficient to justify working. Among the earliest production, perhaps, is that from the Boyd vein in the old Arkansas claim. This is reported to have been approximately $200,000 in free gold and was taken from several drift tunnels and stopes near the north end of the present claim.

To the west, the Gold Belt vein has been stoped during early operation from a lower tunnel. Specific production figures are not known. However, Mr. G. N. McDow estimates that about $20,000 was produced from the primitive processing of ore from the Gold Belt, Neff and Union veins collectively. In addition, the Union property is reported to have produced $50,000 in pocket gold from surface diggings.

In all of the lode operations, milling was done in arrastres or small stamp mills and only free gold was recovered by amalgamation. No base metal existed in the early-mined oxidized ore.

In the last few years there has been some attempt to mine in the district, but, so far, insufficient mine development work has been done to justify large-scale mining and milling operations. Recently, several claims have been surveyed for patent in anticipation of yielding latent mineral deposits.

TOPOGRAPHY

Mountain Slopes.

The Sierra slope in the area covered by this report is a prominent escarpment which rises from about 4000 feet at the valley to over 7000 feet on Diamond Mountain. This slope, north of Diamond Mountain, is not quite so abrupt, however, as found elsewhere along the Sierra to the south. In the vicinity of Diamond Mountain, the Sierra crest swings more to the west, becomes less prominent, and plunges under the lavas of the Lassen Peak region. The higher portion of the Sierra slope is rather marked in relief while the lower slope, in the mineral areas, is less marked and the topography is more mature.

The mountains north of Gold Run Valley are comparatively much lower than the Sierra in elevation, are built of lava accumulations, and are not marked in relief.

Gold Run Valley.

Gold Run valley forms a broad wedge-shaped reentrant between the two mountain slopes. The flat valley with accumulations of recent alluvium ends at a point north of Diamond Mountain, and Gold Run creek swings more to the south and enters a steeper and more confined canyon in the higher mountains. The valley is a marginal feature of the larger drainage basin of Susan River.

Drainage.

The slope of the Sierra is drained by a series of streams which find their way into Lassen or Gold Run creeks. The drainage is northerly on the Sierra slope and all creeks then turn to seek the lower areas to the east and southeast.

A substantial amount of water is supplied by the main creeks of the Sierra slope. This is sufficient for farming and should be adequate for normal mining purposes but it is doubtful if the normal runoff is sufficient for both farming and mining. A number of springs as well as mine workings also contribute to the water supply.

Climate.

As this is essentially a mountain region, the climate is rather marked in distinct seasons. A period of heavier precipitation and cold in the winter is followed by a period of warmth with little precipitation. Snow normally falls in the winter, which lasts from December to March, but is not great on the extreme lower slopes of the Sierra and valley floor. A fairly moderate climate exists for the Diamond Mountain district. Normal annual precipitation at Susanville is about 20 inches.

Vegetation.

The north slope of the Sierra supports a heavy growth of cone-bearing trees. In the past, the stands have been extensively logged off in the more accessible areas. In these places, thick to scattered growths of young timber and brush now exist. The principal trees are yellow, sugar, western and white pines, and douglas fir. Along streams and at springs and seepages, water-seeking willows, cottonwoods and alders are found.

GENERAL GEOLOGY

The general geologic formations of the Diamond Mountain district consist essentially of Mesozoic intrusive igneous rocks. Deposited upon the eroded surface of these are Tertiary gravels, lava and more recent alluvial deposits. The intrusive rocks can be divided into three types (1) biotite-quartz-diorite, (2) hornblende-quartz-diorite and (3) granite. As the mineralized veins and shear zones occur in these rocks, they are the most important geologic formations of the district.

Biotite-quartz-diorite.

Of the intrusive rocks, the biotite-quartz-diorite is host to the economically more important mineral deposits. As shown on the geologic map of the district, it occurs in the head of Gold Run creek, along the north side of Gold Run valley and on the lower Sierra slope from the divide west of Hill creek east to Lassen creek. Over its entire exposure, the rock is largely decomposed and few prominent outcrops are found except for occasional resistant reefs. Therefore, it generally forms less prominent ridges, crests and slopes of the lower country. The soil mantle is quite thick and is a light-colored coarse arkose-sand. The coarse texture of this rock has, no doubt, promoted its deterioration.

In the more decomposed state the rock is light brown in appearance and contains much biotite, decomposed feldspar, and quartz. In fresh exposures, it appears to be composed of cloudy quartz, dull untwinned basic feldspar, hornblende and biotite. The feldspar has a pink or purplish tint. Biotite is the most predominant dark-colored mineral. However, in much of the rock, biotite and hornblende occur in nearly equal quantities.

Under the microscope, the rock is seen to contain largely andesine (Ab_{60} An_{40}) and oligoclase (Ab_{85} An_{15}) feldspars. Quartz is abundant and orthoclase makes perthitic intergrowths with basic feldspars. Biotite is the chief mafic mineral and is altered highly to sericite. Nonessential minerals are magnetite, apatite and zircon. Vermicular quartz along the border of some of the feldspars indicates slight primary alteration of the rock.

In the widespread occurrence of the intrusion, it probably varies from diorite to quartz-monzonite. At one locality, a rock with nearly equal proportions of pink orthoclase and plagioclase feldspar with quartz occurs. Basic clots (schlieren) are scarce and textural variations of the primary rock are not pronounced.

The biotite-quartz-diorite is host to many satellitic intrusions. Of these, aplite and basic dikes are most common while pegmatitic dikes are only occasional. The aplites are most abundant and appear as light cream-colored, fine to medium-grained rock of granular texture. In composition these dikes are probably slightly more acidic than the parent mass. There are no good surface outcrops and those shown on the maps were located by float. These dikes apparently form several systems, are not persistent in strike, dip vertically and are usually not more than a foot or two in width. One system strikes nearly east-west while another strikes northeast.

Basic dikes appear less abundant though this may be due to the fact that they weather more easily. A large dike strikes across the Gold Belt and Tiger claims and is a biotite-diorite-porphyry. It is composed of phenocrysts of plagioclase feldspar in a dark matrix composed of plagioclase, biotite, hornblende, magnetite and zircon. The specimen examined is highly altered with the development of much secondary mica. Other basic dikes were observed in underground workings but generally were extremely altered. The few unaltered dikes were composed almost wholly of hornblende. The relative age relation of acidic (aplite) and basic dikes was not observed. It is likely that the acidic dikes are older as their crystallinity is in many cases coarser than the ground mass of the porphyritic basic dikes. Both are distinctly younger than the enclosing granitic rock as they cut it and are of finer grain. They may be early Cretaceous in age.

Aside from the more important mineral veins in the biotite-quartz-diorite which are described more fully under Economic Geology, there are occasional small veins and random stringers of epidote with quartz.

One important field variation of this rock is that due to alteration by the small acidic intrusion on the east side of Hill creek, which plunges under the surface on the divide to the northeast. In the area enclosed in the dotted line on the geologic map of the district, the biotite-quartz-diorite has been highly altered and silicified with a resulting light to brown or reddish color, and much light mica is apparent. The darker minerals have been bleached and altered so as to give an apparent absence of them, at first glance. Large white glassy masses of quartz and veins occur in quartz-diorite and are probably related to the granite. It seems that much shattering accompanied the granite followed by the introduction of silica solutions. The quartz veins appear genetically different than other veins of the district. Also, there are a few pegmatitic dikes or veins in the biotite-quartz-diorite, which are likely related to the granite stock. These are composed of quartz, alkali feldspar and muscovite. In the upper Lassen creek basin, several large veins occur which contain much coarse crystalline pink orthoclase and white glassy quartz.

Everywhere observed, the biotite-quartz-diorite did not show any surface contacts from which intrusive relations could be determined. Two short cross-cut tunnels did show sufficient evidence to establish a prior age for this rock as compared to the more finely crystalline hornblende-quartz-diorite. However, age difference of these two rocks appears to be slight. On a basis of metamorphism of the biotite-quartz-diorite by the granite, the dioritic rock is the earlier intrusion of the two. The geologic age of granitic rocks of the Sierra Nevada batholith is regarded as late Jurassic.

Hornblende-quartz-diorite.

In the area mapped, this rock occupies the country south of the coarser-grained biotite-quartz-diorite. In two places, lobes of this rock penetrate the coarser rock to Gold Run valley. Being a more resistant rock, it forms a distinct break in slope at its northern contacts and forms the higher and more prominent ridges of the region. Decomposition has not generally been as great as in the coarser granitic rock and the surface mantle is not so thick. The soil is fine and dark gray in appearance.

In fresher exposures, the hornblende-quartz-diorite is generally a fine to medium-grained granitic rock with the light to dark minerals in about equal proportions. To the eye plagioclase feldspar, fine platy biotite and hornblende appear to be the most abundant minerals. Under the microscope, however, quartz and orthoclase are observed in appreciable quantities. The plagioclase feldspar is andesine ($Ab_{65}\ An_{35}$). Zircon, apatite, titanite, magnetite and tourmaline (?) are present as nonessential minerals. Aside from the finer texture, a distinguishing feature of this rock is the predominance of hornblende as the most abundant femic mineral. Also, there is some variation in texture. At one locality near the contact, a border phase of this rock is composed essentially of large prismatic crystals of hornblende and feldspar. In places, these minerals have been drawn out to give a parallel arrangement of dark and light minerals. This is a primary structure and also indicates a later age of this intrusion. Occasionally, the rock contains large bodies of porphyritic hornblende-rich rock. Small segregations largely of hornblende form basic clots which are common. Dikes are not abundant in this rock. Aplites are small, dark, cream-colored and more basic than those in the biotite-quartz-diorite. A few basic (lamprophyric) dikes are of small dimension, green-black in color and distinctly porphyritic.

Prisms of hornblende as well as feldspar compose the phenocrysts in a dense dark groundmass.

Small veins and even large masses and disseminations of epidote occur in the rock, associated with quartz and hornblende. In several localities, the rock is highly epidotized. Veins of economic importance do not occur in this rock as in the coarser biotite-quartz-diorite of the lower region. This condition is pointed out more fully in the discussion of the economic geology. However, a large part of the mineralization in the older granitic rock may be genetically related to the hornblende-quartz-diorite intrusion. As already indicated, this rock is slightly later in age than the biotite-quartz-diorite. It forms a major part of that great composite batholith of the Sierra Nevada.

Granite.

Granite in the region investigated forms a small stock on the east slope of Hill creek. It does not outcrop well and is recognized largely by the abundance of light-colored float. The soil derived from it is very light-colored and fine. To the eye, the rock appears white to cream-colored, and is largely very finely crystalline. Quartz and feldspars are predominant and femic minerals are scarce. In other phases, the pale green laths of hornblende and platy biotite occur in a fine to medium-grained rock of granitic texture.

Under the microscope, the finer-grained light-colored rock is seen to consist largely of quartz and orthoclase feldspar. Plagioclase feldspar as oligoclase ($Ab_{85} An_{15}$) is subordinate. Highly altered biotite is present. The texture is micro-granular and the rock is essentially a granite-aplite.

A few pegmatitic dikes were observed in close association to this body.

Much alteration by hydrothermal and pneumatolytic processes has accompanied the intrusion of the granite stock. This affected the biotite-quartz-diorite and has been described with that rock.

The age relation of the granite cannot be definitely established. Although no intrusive contacts were observed with the biotite-quartz-diorite, because of dike relations, silicification and alteration quite definitely related to it, the granite is regarded as later in age. Presumably, it is later than the hornblende-quartz-diorite and hence is latest of the intrusive series. In this case, the order of the igneous intrusions in the Diamond Mountain region has been one of increasing silicity.

TERTIARY

Auriferous Gravels.

The extent and occurrence of gravel deposits in the area investigated were very limited and no important conclusions can be made concerning them. For a more regional description as to the occurrence, character and age of these deposits the reader is referred to work of Diller[1] and Lindgren.[2]

In this area, Tertiary gravels were found in the head of Gold Run basin and along the south base of the mountains north of Gold Run valley. Their distribution is shown on the geologic map of the district. Here they lie on the eroded surface of the granitic rocks on ridge summits or slopes and are overlain by andesitic lava to the north.

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[1] Diller, J. S., "Geology of the Taylorsville Region, California," U. S. Geol. Survey Bull. No. 353, pp. 68–69 (1908).

[2] Lindgren, Waldemar, "Tertiary Gravels in the Sierra Nevada, California," U. S. Geo. Survey, Prof. Paper No. 93 (1912).

The lowermost beds of gravel are composed largely of cemented, well-rounded pebbles of a great variety of older rocks. Overlying these is a thick series of well-cemented, rounded volcanic pebbles. The pebbles of the older rocks are generally finer in size, being from coarse gravel to pebbles three or four inches in diameter. They are composed of dark siliceous slates, light-colored quartzites, greenstones, quartz, jasper and jasperoid breccias as well as volcanic pebbles of various lavas and tuffs. On the surface the pebbles have weathered out of the fine clastic cement to give a prolific scattering on the hill slopes in places. One broken pebble of dark-green siliceous rock revealed highly contorted but recognizable fragments of a species of marine pecten.

The upper gravels are predominately volcanic. They constitute pebbles that range up to six inches across and are firmly cemented. Outcrops of this mass appear entirely uniform in character. That is, at first glance all pebbles appear similar in themselves and to the cementing medium. On close inspection, a slight dissimilarity can be noted amongst the various pebbles, yet the resemblance is close. The cementing matrix seems to be a flow rock, as a distinct porphyritic texture is present. It appears, therefore, that this gravel was largely water-born volcanic material derived from a similar terrane and later incorporated by a fluid lava also of similar composition. At other localities, the matrix is tuffaceous.

Large rounded pebbles from volcanic Tertiary gravels are thickly strewn over the lower exposures of the granitic rock along the north side of Gold Run valley and they give the appearance of being in place. Actually, however, a heavy arkosic soil can be seen which indicates the presence of granitic rock. The water-worn boulders are very large and easily confused with the somewhat rounded fragments that have weathered out of basal agglomeritic portions of the overlying lava—a point which led to much confusion in attempting to map the contact of the volcanic gravels and the lava.

Tertiary (Pliocene) Lava

Overlying the volcanic gravels and capping the mountain summit north of Gold Run valley is a thick series of andesitic lava flows. Only a small part of the lava was encountered in the northwestern part of the area investigated and the age is inferred from previous work.[1]

The rock observed is dark purplish gray on a fresh surface and weathers to a red chocolate brown. It is composed essentially of dark green prismatic crystals of hornblende and plagioclase feldspar in an aphanitic (glassy) groundmass with the same minerals. No vesicularity was observed. The basal portion of the lava is commonly a breccia or agglomerate. Many of the agglomeritic boulders are from one to two feet in diameter.

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[1] Diller, J. S., U. S. G. S., Bull. 353, p. 94.

PHYSICAL
SCIENCES
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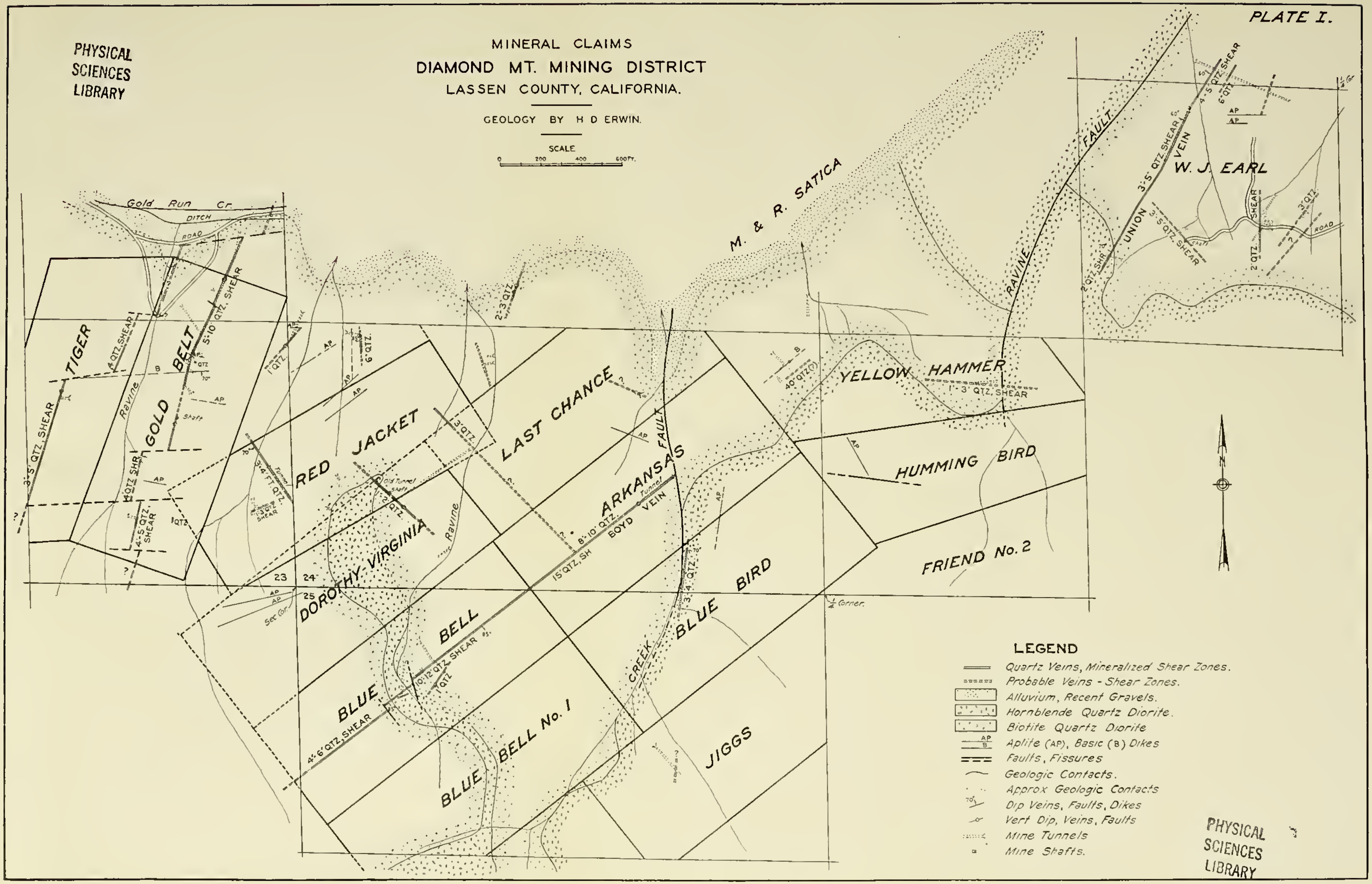
PLATE I.

MINERAL CLAIMS
DIAMOND MT. MINING DISTRICT
LASSEN COUNTY, CALIFORNIA.

GEOLOGY BY H D ERWIN.


SCALE
0
200
400
600 FT.
Gold Run Cr.
DITCH
ROAD
TIGER
3'-5' QTZ. SHEAR
4' QTZ. SHEAR
GOLD
BELT
5'-10' QTZ. 3' SHEAR
Ravine
Shaft
AP
B
4' QTZ SHR.
4'-5' QTZ. SHEAR
1' QTZ.
RED
JACKET
Tunnel
3'-4' FT. QTZ.
3' QTZ. SHEAR
Old Tunnel
Shaft
2' QTZ.
3' QTZ.
6' QTZ.
2'-3' QTZ.
LAST CHANCE
M. & R. SATICA
ARKANSAS
FAULT
Tunnel
BOYD VEIN
8'-10' QTZ.
15' QTZ. SH
DOROTHY VIRGINIA
Ravine
23
24
25
Sec. Cor.
BELL
BLUE
10'-12' QTZ. SHEAR
1' QTZ.
4'-6' QTZ. SHEAR
BLUE BELL No. 1
CREEK
BLUE
BIRD
3'-4' QTZ.
JIGGS
40' QTZ.(?)
YELLOW
HAMMER
1'-3' QTZ. SHEAR
RAVINE
HUMMING BIRD
FRIEND No. 2
¼ Corner
FAULT
W. J. EARL
3'-5' QTZ. SHEAR
VEIN
UNION
4'-5' QTZ. SHEAR
6' QTZ.
3'-5' QTZ. SHEAR
2' QTZ. SHR.
SHEAR
2' QTZ.
3' QTZ.
ROAD
N
LEGEND
Quartz Veins, Mineralized Shear Zones.
Probable Veins - Shear Zones.
Alluvium, Recent Gravels.
Hornblende Quartz Diorite.
Biotite Quartz Diorite.
Aplite (AP), Basic (B) Dikes
Faults, Fissures
Geologic Contacts.
Approx Geologic Contacts
Dip Veins, Faults, Dikes
Vert Dip, Veins, Faults
Mine Tunnels
Mine Shafts.

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Quaternary (Recent) Deposits

Deposits of recent gravels and valley alluvium are largely the result of post-Tertiary to recent stream erosion and weathering. Such deposits are found along the present streams and on the valley floor. These materials consist of various soils, clay, and fine to coarse gravel, as well as larger fragments of all pre-late Tertiary rocks. As this material consists of all previous rocks it naturally is gold-bearing and some recent gravels along the mountain streams have yielded important amounts of placer gold.

A geologically recent process has been the excessive weathering of the bedrock in place to give a heavy overburden of fine-dark to coarse-light arkosic soils over almost the entire region. Until recently the whole region on the Sierra slope was covered by a heavy stand of timber. This has, no doubt, been a factor in the further promotion of rock decomposition with little removal of the material.

Structural Geology

In the area investigated for this report, faulting has been the only structural feature of any importance. Fault movements can be recognized in the rocks mapped as having taken place in at least four separate periods. They are (1) vertical and horizontal vein fissure-forming fault movements, (2) early post-vein vertical movements, (3) early post-vein transverse horizontal movements and (4) more recent vertical movements of great magnitude.

Among the earliest faults are those that gave the repeated fissuring with subsequent formation of the veins and shear zones. Evidence on some of the northerly striking veins shows that early wall movement was horizontal, but, during the later part of the period, the wall movement may have been largely vertical. At least two complementary sets of veins can be recognized in the main area of quartz-diorite north of Diamond Mountain. Whatever may have been the order, direction and magnitude of the movement giving this range of veins is difficult to say. Field relations seem to show that northwest striking veins (complementary to northeast striking veins) are cut off by the northerly striking veins with possibly easterly-westerly components. Mineralizing action was introduced towards the last of the earliest period of faulting. As the veins cut all features in the granitic rock they are later than the fine-crystalline dikes, probably early Cretaceous in age.

After the essential vein formation and mineralization, there was a second period of faulting with an appreciable amount of vertical movement in the plane of the veins and elsewhere. Movement along veins caused the development of much vein and wall-rock gouge. The amount of movement that can be attributed to this early period, however, is difficult to say for, no doubt, some later movements may have contributed to these effects as well.

Possibly during this period, also, the significant faults shown on the northeast part of Plate I were generated by some complexity in the direction of movement.

A third period of faulting gave essentially horizontal and transverse displacements to north-striking veins and were of no great magnitude. These cut the vein and post-vein faults and are most important in the development of some of these veins from a mining standpoint. These two periods of post-vein faulting occurred in the Tertiary.

The latest period of faulting has been essentially vertical since Pliocene time and has resulted in the profound Sierra fault-block and the prominent topographic features of the region. The Honey Lake fault is of this period and has been described by Diller.[1]

Recent earthquakes between the years 1880 and 1885 and 1921[2] indicate that this fault may still be active. Along the front of the Sierra range, north of Diamond Mountain, the topography suggests that several more or less parallel faults break the slope, and uplift has been significant along them as well as on the main front or Honey Lake fault.

Jointing.

As shown in numerous cross-cut tunnels and on surface exposures of higher areas, the granitic rocks of the region are well jointed. The systems are generally not close and usually two rather than three systems are well developed. Not a great many accurate readings were recorded on the attitude of joints as no great importance could be attached to them. At one place, a prominent system of joints strikes N. 80° W. while a less prominent system strikes at nearly right angles.

Geologic History

In so far as the rocks in the region mapped are concerned, little can be made of a detailed geologic sequence of events. However, in the light of studies elsewhere in the Sierra Nevada, it is possible to summarize events which, no doubt, apply to this region.

The previously folded pre-Cretaceous rocks of the Sierra Nevada were invaded by a series of major granitic intrusions in the late-Jurassic. This is represented by three granitic rocks shown on the maps. Fissuring and mineralization followed in a late stage of the igneous activity and gave the gold-bearing lodes now exposed at the surface. The invaded rocks of the folded mountains were attacked by erosion. This continued during the Cretaceous with an eventual encroachment of the sea from the west. The older roof-rocks of the intrusions were largely removed at this period and the underlying granitic rocks exposed. Beginning with the Tertiary (Eocene), uplift was slight and continued erosion accumulated thick deposits of gold-bearing gravels. Relics of these occur on ridges and slopes of the region north of Diamond Mountain. Slight deformation during the Oligocene and early Miocene caused erosion of the mountains and deposition in the great valleys to continue. At the close of the Miocene, lava flows poured forth. Profound uplift occurred in the early Pliocene and erosion continued. The stream-born volcanic pebbles overlying the older rock gravels (auriferous) are evidence of this period in the region of the head of Gold Run Creek. During the Pliocene, also, a thick series of andesitic flows poured forth over the volcanic gravels in the region north and west of Gold Run Valley.

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[1] *Op. cit.*, pp. 101–102.

[2] Kennitzer, W. The Eagle Lake Earthquake of July 21, 1921. Seismo Soc. Amer. Bull. Vol. 11, pp. 192–193 (1921).

PLATE II.

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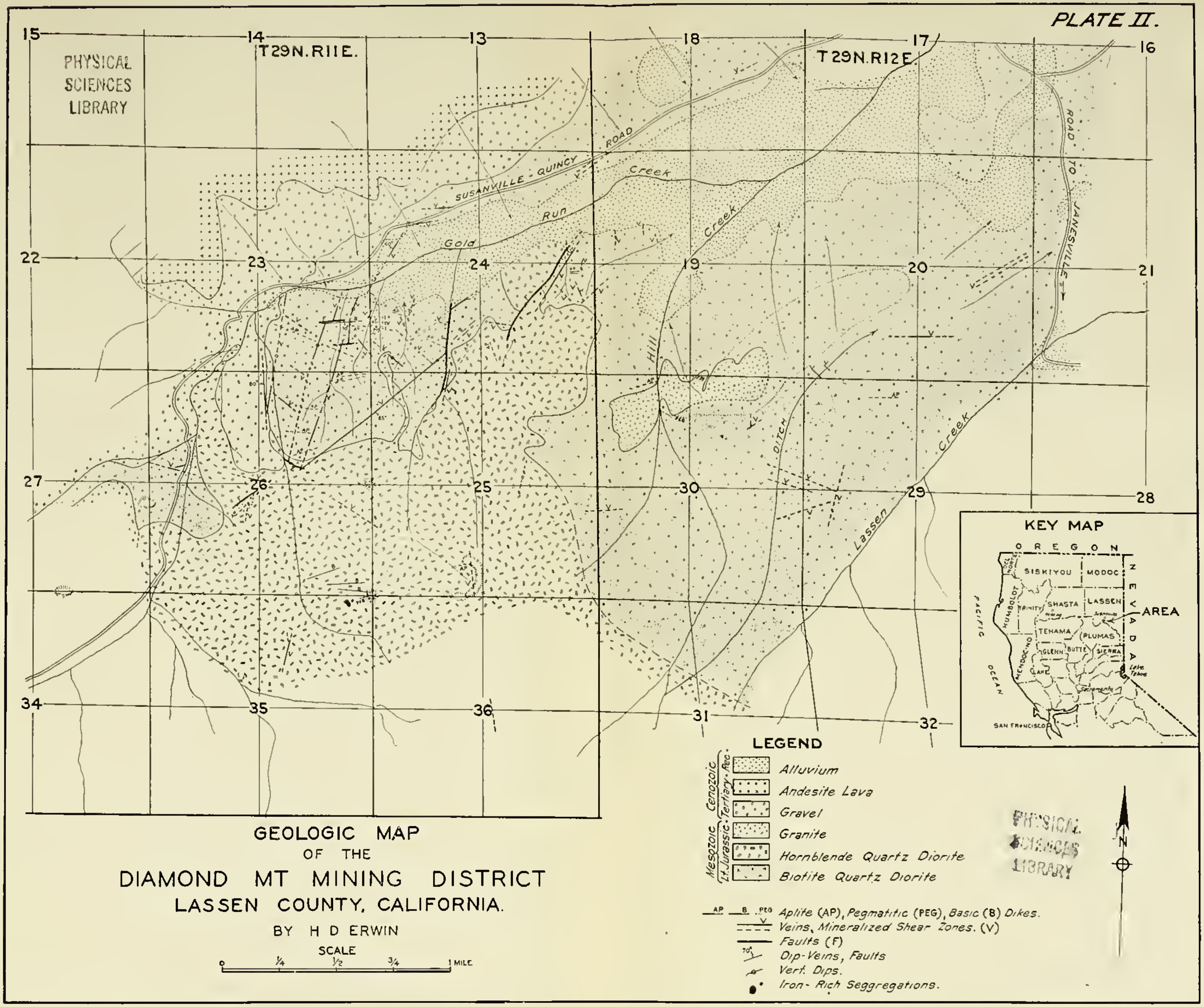
15
14
13
18
17
16
T29N.R11E.
T29N.R12E.
SUSANVILLE QUINCY ROAD
ROAD TO JANESVILLE
Gold Run Creek
Hill Creek
Lassen Creek
Ditch
22
23
24
19
20
21
27
26
25
30
29
28
34
35
36
31
32
KEY MAP
OREGON
NEVADA
PACIFIC OCEAN
SISKIYOU
MODOC
SHASTA
LASSEN
HUMBOLDT
TRINITY
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
LAKE
Lake Tahoe
Sacramento
SAN FRANCISCO
AREA
LEGEND
Cenozoic
Tertiary · Rec.
Mesozoic
Lt. Jurassic
Alluvium
Andesite Lava
Gravel
Granite
Hornblende Quartz Diorite
Biotite Quartz Diorite
AP B PEG Aplite (AP), Pegmatitic (PEG), Basic (B) Dikes.
V Veins, Mineralized Shear Zones. (V)
Faults (F)
70° Dip-Veins, Faults
Vert. Dips.
Iron-Rich Seggregations.
SCALE
0
¼
½
¾
1 MILE
N

GEOLOGIC MAP
OF THE
DIAMOND MT MINING DISTRICT
LASSEN COUNTY, CALIFORNIA.
BY H D ERWIN

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With the late Pliocene and early Pleistocene, the Sierra Nevada block was uplifted on a great scale along its eastern border. This caused pronounced stream erosion and material changes in the drainage of the Sierra. Stream erosion continued with the resulting mountain topography we see today. No evidence of Pleistocene glaciation was observed in the region mapped.

ECONOMIC GEOLOGY

The ore deposits of the Diamond Mountain mining district are of two general types: (1) vein type of gold-quartz deposits enclosed in granitic rocks and (2) auriferous gravel deposits. The vein types of deposit occur in and associated with three principal granitic rocks and are classified as to occurrence by (1) veins and ore mineralization in biotite-quartz-diorite, (2) veins and mineralization in hornblende-quartz-diorite and (3) veins and mineralization in granite. The placer deposits are classified as to age, (1) Tertiary gravels and (2) Recent gravels.

Veins and Mineralization in Biotite-Quartz-Diorite

The granitic rock mapped as biotite-quartz-diorite is host to the more numerous and favorable vein type of deposits in the district. The location of the more important veins in this rock are shown on Plate I. Among the more prominent are the Gold Belt vein, the Tiger vein, the Arrowhead vein and the Boyd vein. The veins of this class are generally not entirely of quartz gangue for in most cases they are accompanied by sheared, silicified and mineralized wall rock as well. Hence, these deposits are really mineralized shear zones in granitic rock. Smaller veins usually, are not accompanied by much sheared wall rock while the wide veins commonly are. The veins and shear zones cut both the aplitic and basic dikes that occur in the parent granitic rock.

In the present underground workings, above the ground-water level of the region, the primary mineralization has been extensively oxidized. This has commonly left a limonite staining of the gangue in all of the surface outcrops and the original nature of the ore can not be determined. In some of the present mine tunnels, however, oxidation has not been complete, and primary ore is to be found. To the eye this consists largely of individual crystals and masses of fine crystals of pyrite scattered through a white, gray or bluish quartz and sheared wall-rock gangue. Free gold was not observed. Both gold and silver are present, as shown by assays. Secondary silica (opal) lines fractures and cavities in some of the gangue.

The vein and shear zones in the biotite-quartz-diorite are exceedingly variable in width, strike, and persistence along the strike, and dip vertically or very steeply. In width they vary from a few inches up to as much as fifteen feet between walls. In strike they cover all quadrants of the compass. The wide mineralized zones are, usually, the most persistent along strike while the intermediate and narrower zones appear less so. From field relations, the most east-west veins are generally less persistent in strike and economically less favorable for ore.

In the eastern part of the region, near Lassen Creek, large veins of white glassy quartz with pegmatitic phases occur. To the east, they are composed of quartz and pink orthoclase and along 1000 ft. of their strike to the west they grade entirely into quartz. Here, seemingly, is found a good example of the lateral gradation of a pegmatitic vein.

The earth stresses and movements that caused the fissures along which the veins developed must have been extremely varied and sustained over a long period of time. The wide zones are regarded as the older, and much of the wall movement generating them was horizontal. Later movements were more or less vertical and contributed to the later generation of the wide zones and the narrower veins and shear zones.

The quartz and wall rock of these deposits is characteristically full of primary cavities as aside from leached cavities. The interstitial space of wall-rock fragments in silicified breccia, and the quartz, contain drusy-lined cavities of small inward-projecting quartz crystals. This indicates that at the time of silicification wall-rock pressures were not great and cavities and openings were sustained in the fissure filling. Under these conditions, the depth of formation must not have been great, possibly in the upper mesothermal zone. Evidence from primary mineralization as exposed to date is not sufficient to further classify the deposits.

The veins and shear zones were formed by repeated movements of the wall rock over a long period of time with the continual introduction of hypogene silica solutions. With repeated shearing and brecciation and fracture filling by silica, the veins grew. However, the amount of silica introduced was not sufficient to seal all the openings in the fissure. After the silica, the sulphides with gold and silver were introduced. As the present mine workings are shallow and few in the district, the geologic control of ore mineralization in the veins is not known. Probably, changes in strike, dips or various bands in the fissures may structurally control the localization of possible ore-shoots. The lack of important mineralization in primary gangue cavities at the present level seems to indicate that the ascending mineral solutions were too weak for a good part of the fissure or that they deposited most of their load in favorable structures at some depth, before reaching higher elevations.

The age of the mineralization is a matter of conjecture. The veins are later than the fine-grained dikes which cut the parent granitic rock and hence younger than late Jurassic, possibly Cretaceous. The mineralization that followed was probably early Cretaceous in age.

Veins and Mineralization in Hornblende-Quartz-Diorite.

Mineral occurrences in the hornblende-quartz-diorite can be subdivided into (1) vein type of deposits and (2) segregations.

Widely scattered occurrences of some of the veins and deposits in the hornblende-quartz-diorite are shown in the general geologic map (Pl. II). These are composed essentially of quartz gangue and presumably the veins are not so wide and persistent in strike as the vein fissures in the biotite-quartz-diorite. This cannot be definitely stated as the outcrops are poor in the heavy overburden. The few surface outcrops show the quartz gangue of these veins to be white and glassy in appearance and unaccompanied by sheared wall rock. Limonite staining is not common. Veins of red or brown quartz occur in the hornblende-quartz-diorite, as indicated by much float.

The geologic indications are that veins in the hornblende-quartz-diorite are of higher temperature of formation as they occasionally contain alkali feldspar and biotite, and border on pegmatitic dikes. Under these conditions, they are not regarded as favorable for economic mineralization although there may be some exceptions. As these veins have been little developed from a mining standpoint, no primary ore could be found. Gold is reported in them.

Apparently the hornblende-quartz-diorite has been a tighter formation for the generation of veins and being slightly later than the biotite-quartz-diorite has not been subjected to as much earth movement and conditions that favored the formation of veins and ore mineralization. However, dikes, veins and mineralization in the biotite-quartz-diorite may be genetically related to the hornblende-quartz-diorite.

Segregation deposits are usually small, discontinuous, iron-rich masses of material occurring at widely scattered localities in the hornblende-quartz-diorite. Generally these bodies form a mass of light to dark brown limonite, decomposed feldspar and sericite in surface outcrops. The outcrops sometimes form rude alignment in the granitic rock but each mass is definitely separated on the surface. They may form pipe-like bodies for some depth, though they are not regarded as extending very deep.

One isolated exposure is a relatively fresh siliceous mass in the fine-grained hornblende-quartz-diorite, and contains a reddish iron oxide. This, also, is believed to be a magmatic segregation.

Veins and Mineralization in Granite.

Few quartz veins were observed in the granite though many are apparently related to this intrusion. In the eastern part of the area investigated, an exceedingly large amount of white glassy quartz occurs in the altered and unaltered biotite-quartz-diorite, adjacent to the small stock of the granite. None of these veins appears of economic value, however.

Pegmatitic dikes or veins and masses composed of white quartz, cream-colored or pink feldspar and muscovite are found in the granite but little economic importance can be attached to these.

PLACER DEPOSITS

Gold-bearing Tertiary and Recent gravels have been described under the general geology as to occurrence and character. Old diggings show that pay-streaks in the various gravels are widely scattered over the district. Little is known of the production, but a few notes are given in preceding paragraphs under the historical sketch of the region. Future economic considerations are, likewise, noted elsewhere.

ECONOMIC POSSIBILITIES

Lode Mining.

The Diamond Mountain district, north of Diamond Mountain, is known to have produced some lode-gold, and sampling of most of the veins in the district substantiates this fact. The geologic conditions for the economic occurrence of gold are favorable. However, to the present time insufficient mine development work has been done in this district to show commercial bodies of ore. Either small high-grade or large low-grade deposits may be possible but indications show that the latter are the more likely. It remains to be seen what well-planned and systematic development work over the district will prove in the matter of future mining possibilities. One point brought out as a result of the present investigation is that most of the gold of recent placer deposits has been derived largely from the reworking of Tertiary gravel deposits and has not been derived from the erosion of veins in the near vicinity. Nevertheless, gold does occur in the veins and development work should show its continued importance.

Geologic mapping of the district shows that the possible importance of vein intersections in the localization of orebodies has not yet been recognized; also, that vertical and lateral development of known veins have not yet been carried far enough to be conclusive as to the occurrence of ore-shoots.

As the important mineral areas are of low relief, ore would eventually have to be mined through shafts. This is a consideration if only low-grade ore is developed in the more important veins. Some water can be anticipated in mine workings projected below the water table of Gold Run valley. Timber is plentiful and the region could be easily reached by a railroad.

Placer Mining.

Accessible rich placer deposits have been well worked out in the Diamond Mountain mining district. There may be some possibility in the present valleys, which have been preserved because of agricultural pursuit. Thorough sampling may show economic possibilities for dredging or some form of operation on these lands. In this case, it remains to be seen which is the more valuable asset—gold or future farming. Certainly any less desirable agricultural land would justify the consideration of placer operations.

HAYDEN HILL MINING DISTRICT

The Hayden Hill mining district has been described in Bulletin 594 of the United States Geological Survey by James M. Hill, and we have drawn freely from that paper in what follows:

This district is in the north central part of the county. The town of Hayden Hill is near the head of the west fork of Willow Creek, 16 miles south of Adin, at the west base of the low, rounded knob from which it is named. The nearest point on the Southern Pacific Railroad is Canby, about 30 miles north of Hayden Hill.

Topography.

The town of Hayden Hill lies at an elevation of 5400 feet, at the west base of the hill of that name, which attains an elevation of 6357 feet. This hill rises about 900 feet above the relatively level basalt-covered plains. On the south and west it has gentle even slopes to a point within 75 feet of the summit, which takes the form of a sharp peak. On the north and west it is very different as branches of Willow Creek have cut in close to the hill. On the north, there is an abrupt rise of 150 to 300 feet near the summit, below which the slopes are very steep for another 300 feet. On the east the hill rises 1200 feet in a little over a mile with a rather flat bench 1000 feet wide, 500 feet below the summit.

Geology.

Hayden Hill is composed of buff-colored to yellowish rhyolite tuffs. The bedding is distinct, being in some places horizontal and in others dipping at a low angle to west-southwest. These beds differ in appearance, some of them being composed of rather coarse agglomerate, and others being fine-grained consolidated muds. Under the microscope the soft sandstone-like tuffs are seen to be composed of fragmental glass, containing here and there a few fragments of orthoclase. Quartz grains are rare. The low flat to the south and southwest of the hill is underlain in part by a soft, partly consolidated, dirty buff-colored rhyolite tuff, in which quartz and glass grains predominate, though some orthoclase and plagioclase feldspars are seen. About two miles north of Hayden Hill on the road to Adin, Willow Creek has cut deeply into soft greenish-white tuffs, which appear quite similar to those south of the hill. In this rock quartz, glass and fragments that appear to be pyroxene are set in a kaolinized matrix. At the summit of the hill these tuffs have been brecciated and silicified and cemented by white quartz. This hard rock forms the peak at the top of the hill, and the scarp along the north side.

The silicification and brecciation appear to have occurred in a fault that was slightly concave to the south-southeast, and which has raised the beds to the southeast forming Hayden Hill. This fault zone strikes about N. 50° E., and the amount of vertical displacement seems to have been greater to the east-northeast near the summit of the hill than in the vicinity of the town of Hayden Hill. The low flat to the south and southwest of the hill is underlain by a soft, partly consolidated dirty buff-colored rhyolite tuff. The tuffs are probably of Tertiary age.

Ore Deposits.

The veins of Hayden Hill are confined to the area west of the summit, and the richest of them occur in the long even-sloping southwest side.

The most productive veins were the Providence, Golden Eagle, Juniper, Brush Hill and Hayden Gulch. There are two distinct sets of veins, one striking about N. 68° W. and the other N. 38° E. The northeast veins appear to be younger than the northwest veins, and movement along the Providence vein has displaced the Golden Eagle, as at the northwest end of all the levels the Golden Eagle swings to the north on approaching the Providence. The two northeast veins, near the main shaft of the Golden Eagle, clearly cut that vein.

Structure of the Veins.

As a rule the veins of Hayden Hill have steep dips. In general the northwesterly fissures dip 60°–70° NE., though in many places in the Golden Eagle Mine the vein is vertical.

The northwesterly fissures are as a rule nearly vertical, but at the junction of the Providence and Golden Eagle veins the Providence has a dip of 45° SE. Most of the fractures are 1 foot to 10 feet wide, but some are as wide as 25 feet. The filling of all the veins is a soft, consolidated fault breccia of the adjacent wall rock, much of the material being as small as sand grains. Both the country rock and the ore are more or less iron-stained and the richest ore contains a large amount of pyrolusite. This rich ore occurs in irregular pockets throughout the main vein. The rich veins are remarkable for the small amount of quartz they contain. Most of the ore at Hayden Hill consists of particles of free gold in gouge and ochre seams occurring in the volcanic series of rhyolitic tuffs and breccias. A vein at the Juniper mine, however, contains considerable quartz of the chalcedonic variety. It is said to always give a good assay in gold; but the mud-seams with oxides of iron and manganese contain free gold also. The total width of the shear-zone is from one foot to a maximum of seven feet but the quartz may be only a fraction as wide or it may occur only in irregular bunches. The metal is a combination of gold and silver, being higher in silver and lower in gold than typical Californian gold.

LASSEN COUNTY MINES

COPPER

The southern portion of Lassen County is not far from the Engels mine in Plumas County, which has been a very large producer of copper. Similar mineralization is to be found in the southern portion of Lassen County, but to date, the deposits are only in the prospective stage and very little production has resulted.

Coast Copper Co. (Mountain Meadows Copper Mine). Some prospecting for copper has been done on this property, which comprises five patented claims—the Copper Queen, Native Copper, Copper King, Native Copper No. 2, Copper Ledge No. 4, located in Sec. 29, T. 28 N., R. 10 E. Some showings of copper have been found in a 200-ft. tunnel driven some years ago, but apparently no production has resulted, and the property has been idle for a number of years. A deed on file in the County Recorder's office at Susanville indicates that this property has been transferred to C. F. Huling, H. N. Huling and Sidney L. Taylor, of Woodbury County, Iowa. This deed was acknowledged at Sioux City, Iowa, in December, 1934.

Bibl: State Mineralogist's Report XV, pp. 228, 229; XVII, pp. 507, 508.

Corona Mining Co. Some years ago a company of this name held 700 acres of locations in the NW. part of T. 26 N., R. 15 E., at a point one mile south of the state highway from Susanville to Reno at a point 13 miles north of Doyle, a station on both the Western Pacific and Southern Pacific railroads. A. C. Marr was president at the time that the work was done and later E. G. Scammon, of Westwood, was president. A small amount of disseminated chalcopyrite occurs here in diorite, but some 700 or 800 ft. of workings driven by this company failed to develop any ore of commercial grade.

Bibl: State Mineralogist's Report XXV, p. 5.

GOLD

Arkansas Claim. The Arkansas claim of Lyman Styles, Susanville, California, and Will Long, adjoins the Blue Bell claim of Harris and Musgrove to the northeast and lies principally in the SE$\frac{1}{4}$ of Sec. 24, T. 29 N., R. 11 E.

On this claim, the northern portion of the Boyd vein reaches its maximum proportions. Some of the earliest lode mining in the district was done on this property. From the creek level a series of drift tunnels were run on the Boyd vein and portions of it were stoped. Little can be ascertained about these operations and all workings have long been caved; however, it is reported that about $200,000 was produced.

The vein here has its usual strike of N. 51° E. and vertical to 80° SE. dip. The width between biotite-quartz-diorite walls runs up to 15 ft. and the gangue is an ocher-stained, fractured quartz containing drusy cavities. At the creek level, to the northeast, the vein is cut off by a significant cross fault running parallel with the creek, and does not continue along its strike to the northeast.

Badger, see Honey Lake Gold Mines.

Brown Property. South of Earl (Honey Bee) and Clark, H. Brown, Susanville, California, owns a tract of timber land, part of which is regarded of mineral value.

As this property is largely in an area of hornblende-quartz-diorite, few veins were observed. At one place a shallow shaft has been sunk on a pegmatitic dike which is associated with the granite on the east portion of the property. This seems unfavorable for gold.

Much placer mining in the past is evident on the northeast portion of the property. Most of this work was done in recent gravels which are regarded as reworked portions of old Tertiary gravels.

Clark Property. Mr. E. Clark, Susanville, California, owns a tract of land of which the north 40 acres designated as the NW$\frac{1}{4}$ of the NE$\frac{1}{4}$ of Sec. 30 is regarded as mineral land.

Little lode mining has been done on this property except that several surface pits have been sunk on supposed vein matter. Production in the past has been confined to placer mining.

Investigation shows that the geologic conditions here are less favorable for the development of lode gold deposits. A few surface pits have been sunk on pegmatitic dikes or veins associated with the granite in that vicinity.

The recent deposits of placer gold were derived from an old stream channel that existed at or near the present ridge summit, east of Hill Creek.

Earl Property, see Honey Bee.

Emerson property. Tro Emerson of Susanville, California, owns a large tract of land in T. 29 N., R. 12 E., M. D. M., part of which is regarded as being of mineral value. No lode mining has been done in the past on this property but placer operations have been rather extensive at several localities.

Near the SE. corner of the SE$\frac{1}{4}$ of the NE$\frac{1}{4}$ of Sec. 20, T. 29 N., R. 12 E., an exceedingly wide mineralized zone occurs in the biotite-quartz-diorite intrusion. This zone is cross-cut by a 120-ft. tunnel and the face is still in mineral. A curving drift extends westerly for 350 ft. and apparently leaves the mineralized zone at one point. These workings show the deposit to consist of a wide zone of sheared, silicified granitic rock and quartz veins impregnated with small to large masses of pyrite with a low gold content. Small pegmatitic dikes containing alkali feldspar, quartz and muscovite occur in the fissure and likewise contain pyrite. Post-mineral movement has granulated the quartz and sulphides in places, and gouge has been developed. Partial oxidation has taken place. The strike of the mineral zone is about N. 50° E. with dip vertical. The granitic rock appears to approach a quartz monzonite here, as alkali feldspar is an important constituent in the rock.

South of the center of Sec. 20, slightly over a quarter of a mile, an E-W. striking vein is reported to persist over some distance, though it is poorly exposed. It is several feet wide and composed of ocher-stained fractured quartz.

In the NW$\frac{1}{4}$ of the SE$\frac{1}{4}$ of Sec. 16, T. 29 N., R. 12 E., there are extensive old placer diggings. This deposit is a relic of an old channel, and the slightly reworked gravels show a great variety of old country rock pebbles which are well rounded by stream action.

Gayman-Spaulding Claims. The property of C. F. Gayman and the J. B. Spaulding estate comprises six unpatented mining claims, namely, the Red Jacket, Last Chance, Blue Bird, Yellow Hammer, Humming Bird and Friend No. 2. Adjoining the Tiger claim to the east and the Satica property to the south, the Red Jacket, Last Chance and Yellow Hammer claims lie on the lowermost slope of the mountain range. The Humming Bird and Friend No. 2 claims lie higher on the slope above the Yellow Hammer claim. All of the group of claims lie largely in the S$\frac{1}{2}$ of the SW$\frac{1}{4}$ of Sec. 24 and the SW$\frac{1}{4}$ of the SE$\frac{1}{4}$ of Sec. 24, T. 29 N., R. 11 E.

Most of the mining in the past on this group of claims was done on the Red Jacket claim. Here, a number of old tunnels have been driven but only one shows evidence of much stoping. During this operation a 450-ft. cross-cut tunnel was driven to exploit 100 ft. or more of backs on a vein striking N. 47° W. and dipping vertically. Nothing is known of the value of ore produced from these workings. Since 1911, C. F. Gayman has driven several tunnels on the Red Jacket, Last Chance and Yellow Hammer claims but, to date, no extensive mining has been done.

On the Red Jacket claim, most of the veins strike in a northwesterly direction in the biotite-quartz-diorite country rock. They consist of sheared, silicified wall rock and quartz veins, all of variable width. Little can be definitely said as to the persistence of these veins in strike as good surface exposures are wanting. In character, these mineralized zones are similar to the Gold Belt, Tiger and Boyd veins. On the western portion of the Red Jacket claim are two tunnels. One tunnel cross-cuts 30 ft. and drifts east 40 ft. on a vein which strikes N. 87° E., and dips vertically. A 130-ft. drift tunnel a short distance to the northeast is on a vein which strikes N. 37° W. and dips 75° to the southwest. This vein strikes toward the Gold Belt vein, which it may intersect. Both veins are from 2 to 3 feet wide.

Near the center of the Red Jacket claim are several old tunnels about which little is known. One tunnel was driven south for about 120 ft. on a two-foot vein, which strikes N. 47° W. and dips vertically. This vein has been stoped out immediately under this old tunnel by operations through the 450-ft. cross-cut tunnel already mentioned.

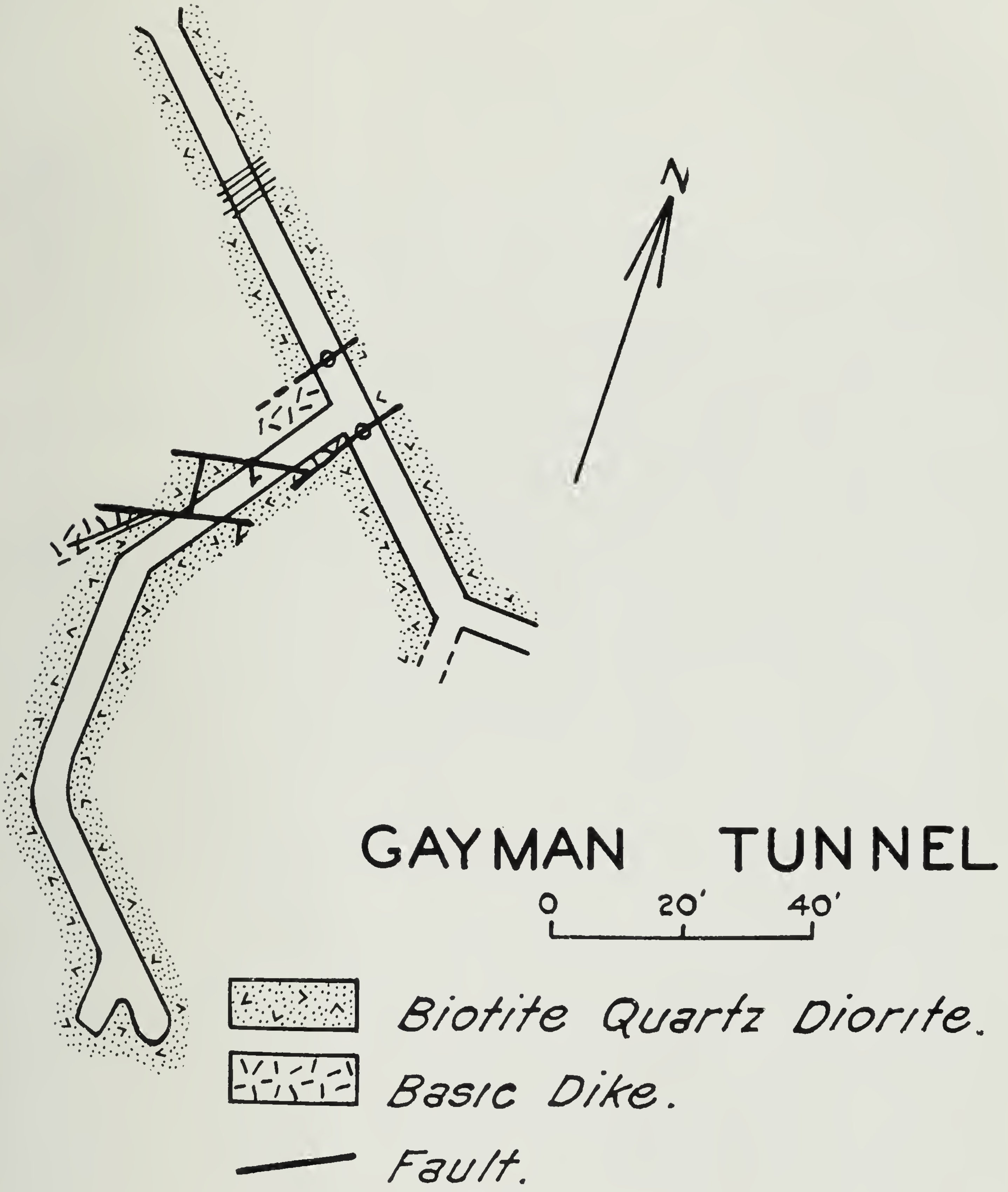

FIG. 2

The wall rock is biotite-quartz-diorite; however, the vein cuts the northernmost extremity of the long hornblende-quartz-diorite off-shoot. (See Plate I.)

A poorly exposed vein outcropping near the eastern end line of the Red Jacket claim strikes about N. 45° W. and is supposed to intersect the Boyd vein on the south portion of the Arkansas claim some 700 ft. to the southeast.

A short drift tunnel is reported to expose a narrow vein which strikes N. 64° W. on the Last Chance claim.

On the central portion of the Blue Bird claim surface cuts expose a prominent ocher-stained quartz vein for 400 ft., 3 to 4 feet wide, which strikes N. 9° E. and dips steeply to the SE.

On the northwest portion of the Yellow Hammer claim, C. L. Gayman has driven a 130-ft. cross-cut tunnel through the coarser grained quartz-diorite country rock. This intersects a wide altered basic dike and is reported to intersect a narrow gold-bearing quartz vein carrying pyrite, chalcopyrite, and free gold. Chrysocolla and bornite form secondary stainings in the ore on the dump. Gayman reports to have recovered several hundred dollars in free gold from some surface diggings above this tunnel. Surface cuts expose several other veins.

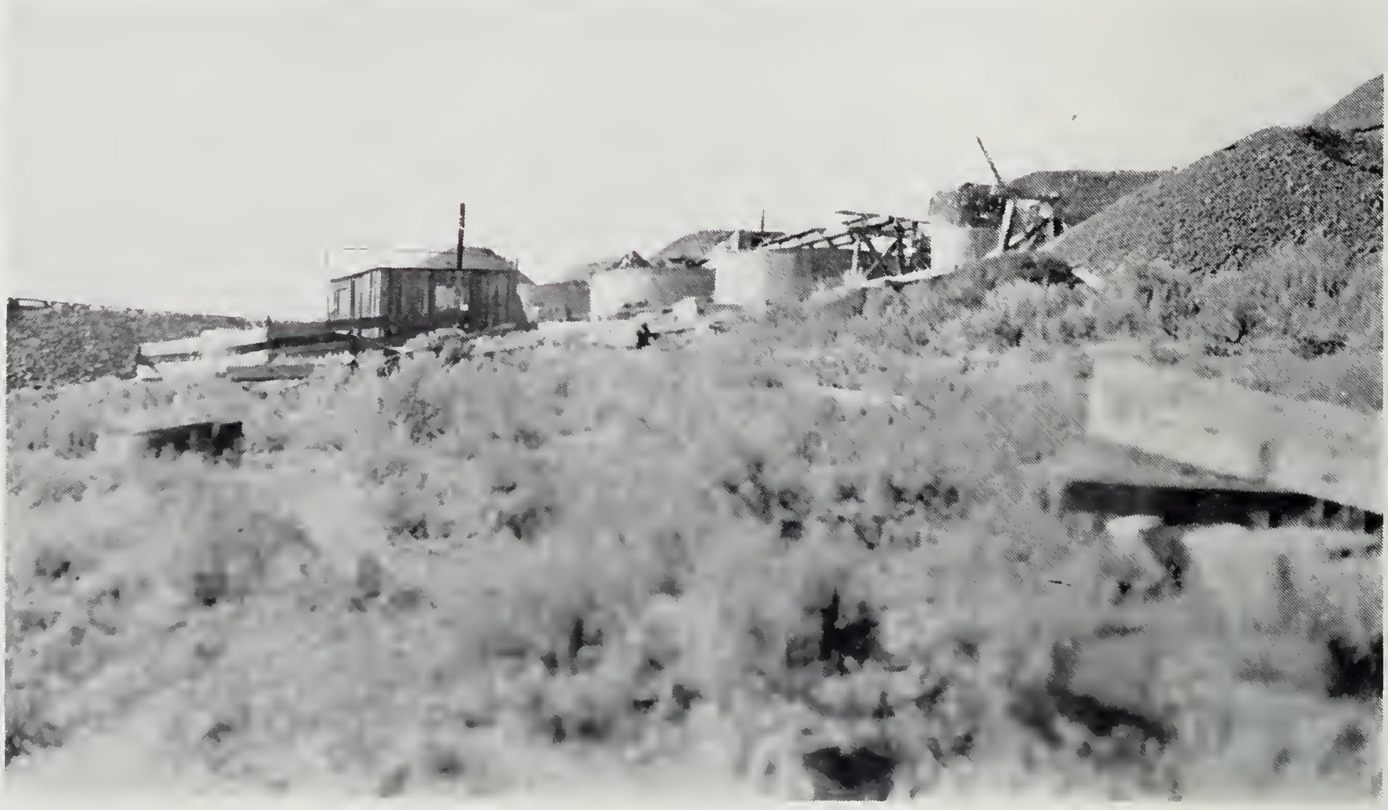

FIG. 3. Cyanide leaching equipment at Golden Eagle, Hayden Hill District

Golden Eagle Mine is one of the old productive groups of the Hayden Hill district adjoining the Blue Bell group on the east. It has been taken over by *Hayden Hill Gold Corporation,* which see below. According to Tucker[1] two veins have been developed; the Golden Eagle vein strikes N. 45° W., dipping 75° NE., while Evening Star or Providence vein has a course of N. 38° E. with a vertical dip.

The Golden Eagle vein varies in width from 1 ft. to 25 ft. The length along the lode on Golden Eagle vein is 3100 ft., while on Evening Star vein it is 4500 ft. Southwest of Golden Eagle vein, a 6-ft. by 10-ft. shaft has been sunk to a vertical depth of 835 ft. Levels have been driven on the vein at 150 ft., 200 ft., 300 ft., 400 ft., and 500 ft. to the end lines of the Golden Eagle claim. The vein has been stoped out from 400-ft. level for a distance of 400 ft. east of shaft. West of shaft for about 300 ft. the vein has been stoped from 400-ft. to 220-ft. level. On 150-ft. level is a cross-cut from shaft 40 ft. north to vein, with a drift 500 ft. east, and 560 ft. west on main vein; at 60 ft. west of shaft there is a drift 240 ft. west on a sub-parallel vein. On 220-ft.

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[1] Tucker, W. Burling, State Mineralogist's Report XV, 1915.

level a cross-cut was driven 20 ft. north to vein with drifts 680 ft. east and 400 ft. west; at a point 40 ft. west of shaft there is a drift 300 ft. west on a sub-parallel vein. On 300-ft. level, vein was cut 75 ft. north of shaft, and drifted on 600 ft. east and 600 ft. west with a drift 300 ft. east on sub-parallel vein. These parallel veins are from 20 ft. to 40 ft. apart on this level. On 400-ft. level is a cross-cut 80 ft. north of shaft to vein, with drifts 360 ft. east and 580 ft. west. On 500-ft. level is a cross-cut 85 ft. north to vein, with drifts 140 ft. east and 250 ft. west.

In 1934, dumps on the Golden Eagle were being worked with a crew of four men by Austin Woods and W. L. Merrill of Adin. The dump-ore was moved with a scraper attached to a double-drum gasoline hoist. Sizes above five-eighths-inch were rejected immediately by a trommel-screen, and trammed in mine cars to the lower dump. Sizes under five-eighths-inch were leached in tanks with a three-pound cyanide solution. There were three of these leaching tanks, corrugated iron tanks with filter bottoms, 16 ft. in diameter by 4 ft. deep. The dump material was handled at the rate of 100 to 125 tons per day, and the ratio of coarse material to fine varied from 7 to 1, to 3 to 1. Water was added to the trommel on account of the sticky nature of the ore.

Bibl: State Mineralogist's Reports XV, p. 231; XIII, p. 200; XII, p. 149; X, p. 275; IX, p. 212.

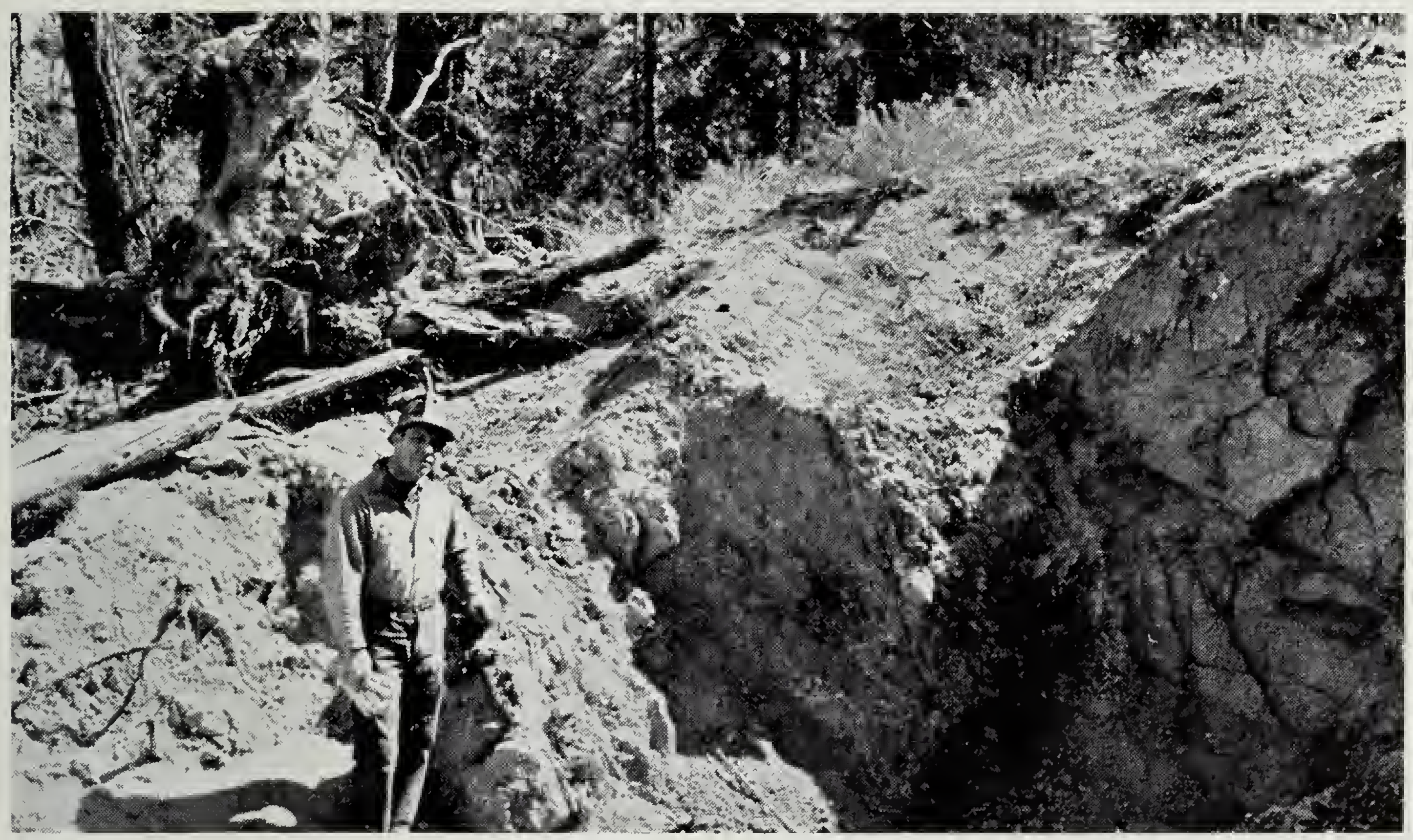

Fig. 4. Discovery point on Boyd vein on Blue Bell claim of Harris and Musgrove, Diamond Mountain District, typical of surface exposures of the district

Harris and Musgrove Claim (including Blue Bell). This group of claims, owned by M. L. Harris, of Santa Cruz, California, and C. L. Musgrove, of Sacramento, California, consists of the larger part of one mining claim, the Dorothy-Virginia and two full claims, the Blue Bell, and Blue Bell No. 1. The property adjoins the McDow property, on the east and lies higher on the slope of the range largely in the

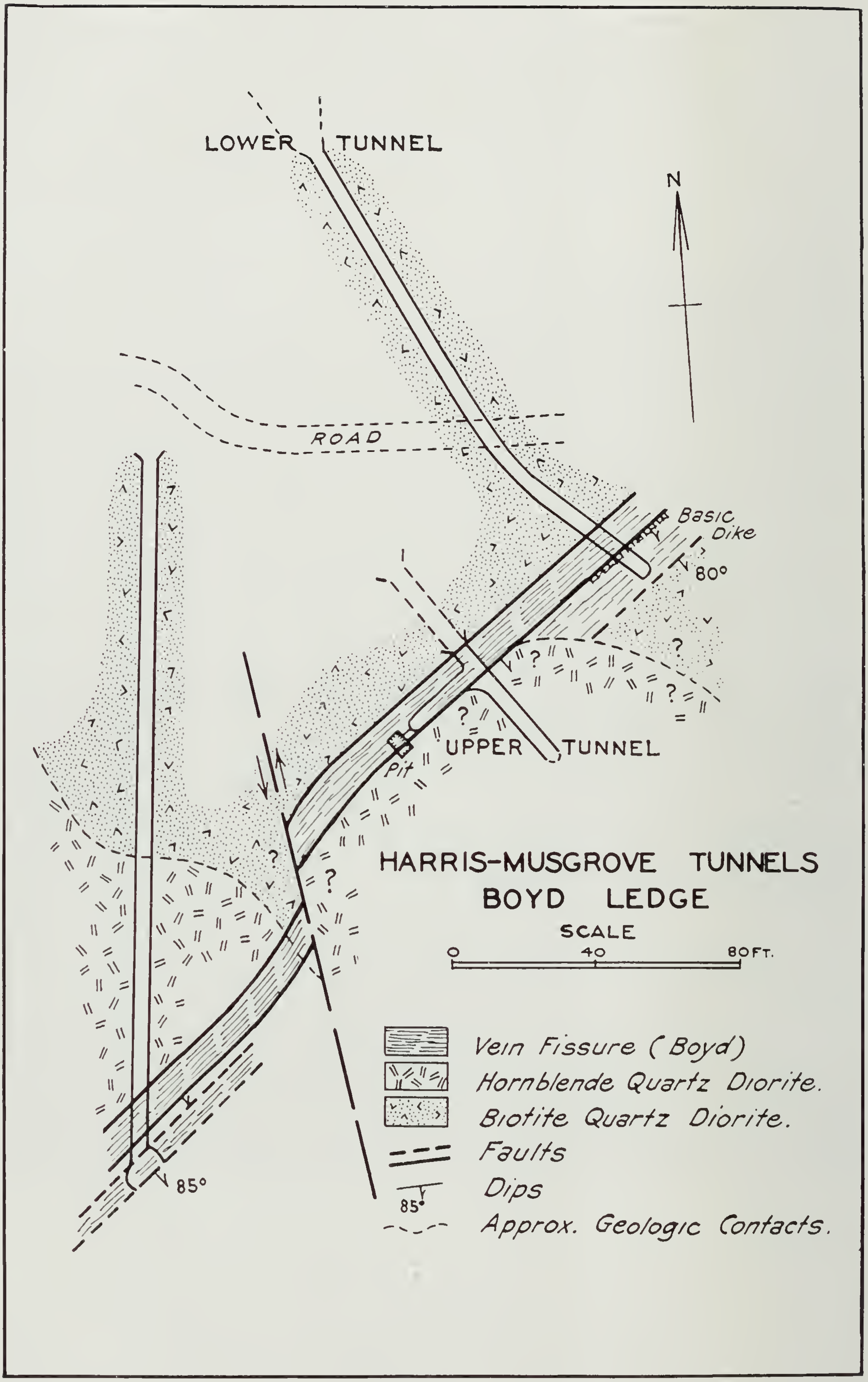
LOWER TUNNEL
N
ROAD
Basic Dike
80°
?
Pit
UPPER TUNNEL
85°
HARRIS-MUSGROVE TUNNELS
BOYD LEDGE
SCALE
0
40
80 FT.
Vein Fissure (Boyd)
Hornblende Quartz Diorite.
Biotite Quartz Diorite.
Faults
Dips
85°
Approx. Geologic Contacts.

Fig. 5

SW¼ of the SW¼ of Sec. 24, and in the NW¼ of the NW¼ of Sec. 25, T. 29 N., R. 11 E., M.D.M.

Little can be found out regarding past mineral production on what now constitutes this property. Several old tunnels bear witness to the fact that some lode mining was done. At one place, near the northeast corner of the Dorothy-Virginia claim a long (450-ft.) cross-cut tunnel intersects a vein striking N. 47° W., which has been stoped to the surface. The largest vein on the property is known as the Boyd vein, and it strikes through the center of the Blue Bell claim in a N. 51° E. direction. Much early work has been done underground and at the surface on this vein but there has been little actual mining. Two old cross-cut tunnels apparently did not strike favorable portions of the vein. The extent of operations at an old inclined shaft is likewise unknown.

More recently, the Boyd vein has been further exposed on the surface by cuts and at one place a short cross-cut and drift trunnel has been driven. The plan of this tunnel and the two older cross-cut tunnels is shown in Figure 5. All of the workings show the vein to be persistent in strike for nearly a mile, though it is offset in at least two places by tranverse faults. The dip is steep, vertical to 80° to the southeast.

Like the Gold Belt and Tiger veins, the Boyd vein is a prominent zone of limonite-stained, fractured vuggy quartz with silicified wall rock and wall rock breccia. Much gouge has been developed in the vein and on the walls of the fissure near the center of the Blue Bell claim, which indicates much post-vein movement. The wall rock is predominantly biotite-quartz-diorite, partially decomposed in all present workings, and at one point the vein is cut by a narrow off-shoot of finer quartz-diorite. In the latter rock, the vein apparently pinches down in width.

Immediately south of the Boyd vein, near the center of the Blue Bell claim are two branching veins. Two vertical, two-compartment shafts have been sunk to a depth of 15 or 20 feet on one vein which strikes N. 30° E., and dips vertically, and is about a foot wide. This is a white vuggy quartz with an absence of any ocher staining. Another small vein strikes N. 72° E.

Bibl: State Mineralogist's Report XXV, p. 6.

Hayden Hill Gold Corporation is the only present operator in the Hayden Hill district. Officials include: W. J. Stratton, president, Symons Building, Spokane, Wash; C. O. Dunlap, secretary; W. P. White, engineer, and at the mine F. H. Brown, mine superintendent, and J. Moisan, mill superintendent. This corporation has taken over the Blue Bell group of 10 claims from H. P. Anderson, the Golden Eagle group of five claims from Lassen Mining Co., and the Juniper patented claim from Chenoweth & Leininger and others of Redding. Additional claims have been located by the corporation. The mine address is Adin, California.

In 1934, the 160-ft. shaft on the Blue Bell had been cleaned out and had been sunk to the 220-ft. level. At the 200-ft. level an east drift had been driven 220 ft. and a west drift 90 ft. There were two cross-cuts to the north of 120 ft. and 80 ft. and two cross-cuts to the south of 140 ft. and 60 ft.; also a raise to the 100-ft. level, which is an old level. The new work was stated by R. H. Fritz, who was foreman at that time, to have developed a block of ore 60 ft. wide and 60 ft. long, between the 200-ft. level and the 100-ft. level, assaying $6 to $20 per ton in gold. This is in a shear-zone in a rhyolitic series of tuffs and breccias. The free gold occurs in ochre and gouge seams with some manganese staining. Practically no vein quartz is to be seen in this ore. At that time ore from this work was being sorted on the dump and the fines were being treated in a Straub ball mill of a

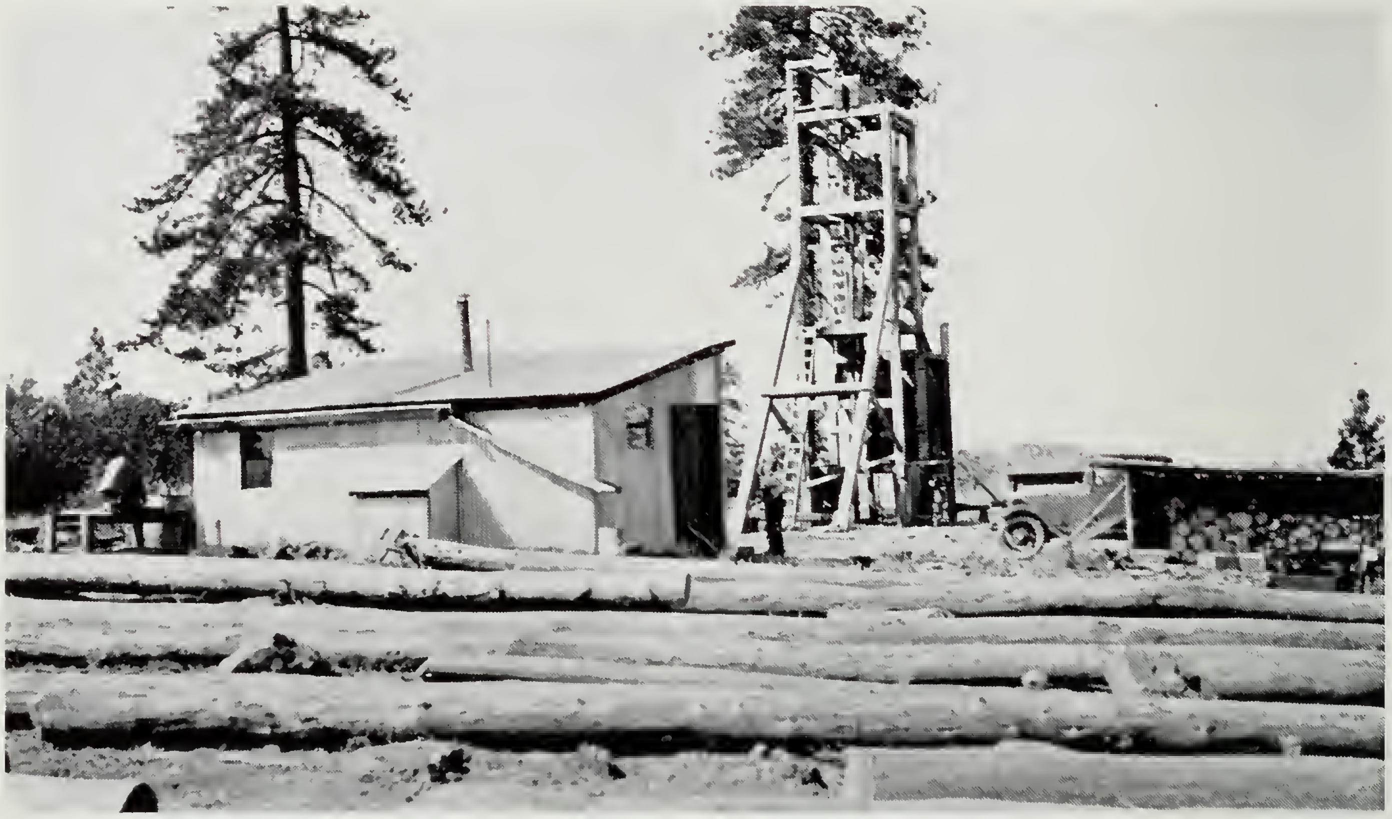

FIG. 6. Shaft on Blue Bell group of Hayden Hill Gold Corporation

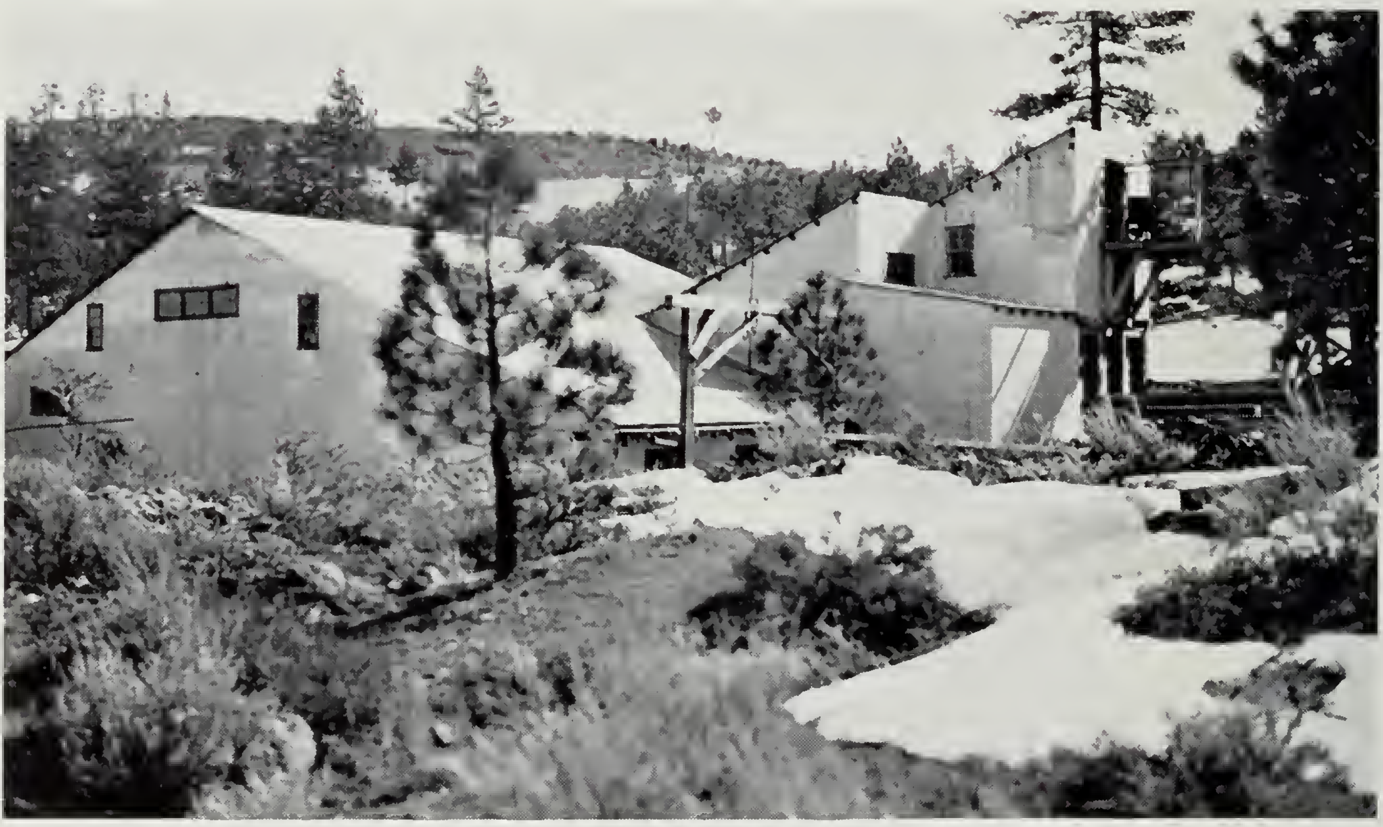

FIG. 7. Cyanide mill, 25-ton, of Hayden Hill Gold Corporation

capacity of four tons in eight hours. The only treatment was amalgamation on plates. At the same time a tunnel on the Alturas claim was being cleaned out to reach the Evening Star shaft of the Golden Eagle group at the 300-ft. level. The total distance from the portal to the shaft is 1000 ft.

Early in 1936, ore was being produced with a crew of 10 men from the 100-ft. level of the Juniper near the shaft to supply the new 25-ton cyanide mill. It is of the all-slime type and contains a jaw crusher; ball mill $4\frac{1}{2}$ ft. by 8 ft., outside dimensions; Dorr classifier of the rake type; three Dorr agitators and five Dorr thickeners. Agitators are roughly 10 ft. in diameter by 10 ft. deep, and thickeners 24 ft. in diameter by 15 ft. deep. The process is a continuius one, tailing being discharged from the last thickener without filtration. The Merrill-Crowe system is used for precipitating the gold from solution with zinc-dust. Power is supplied by two McCormick-Deering diesel engines of 50 hp. each.

The average crew, including three shifts in the mill and the surface men, varied from 20 to 25 men. New buildings include an office, a cook house and a bunk house. All water for Hayden Hill must be pumped from Willow Creek through four miles of pipe and with a lift of 1200 ft.

Bibl: State Mineralogist's Reports XXV, p. 7; XV, p. 231; XIII, p. 200; XII, p. 149; X, p. 275; IX, p. 212.

Honey Bee property. The principal parcel of land owned by W. J. Earl, of Susanville, California, comprises 60 acres designated as the $N\frac{3}{4}$ of the $E\frac{1}{2}$ of the $SE\frac{1}{4}$ of Sec. 24, adjoining M. & R. Satica's land on the southeast. A second parcel is a triangular fraction in the N. portion of the $SW\frac{1}{4}$ of the $SW\frac{1}{4}$ of Sec. 24, T. 29 N., R. 11 E.

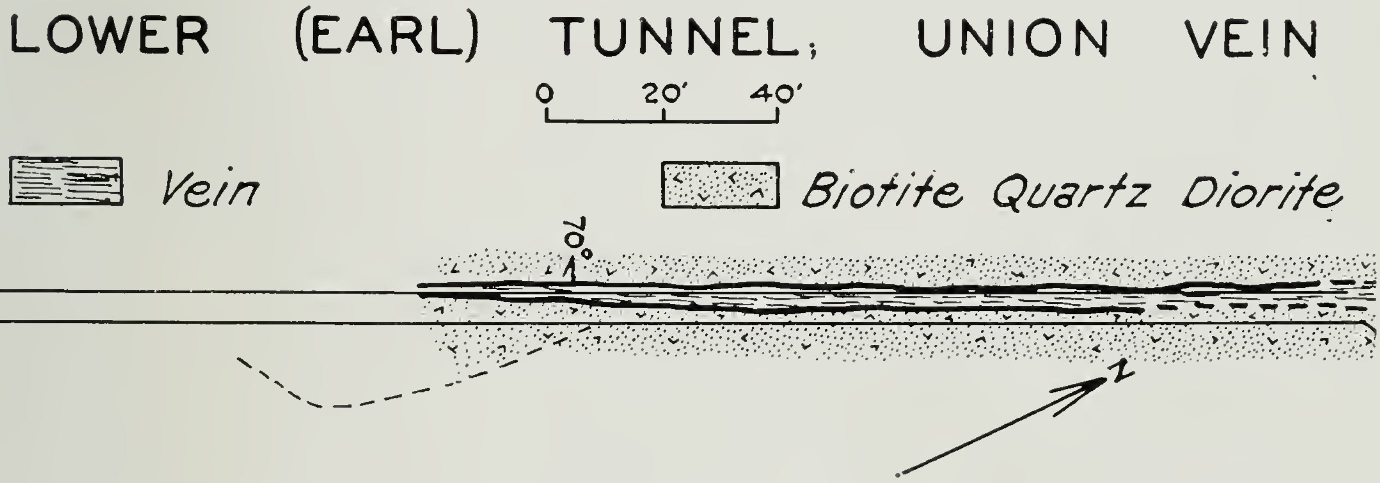

FIG. 8

Rather extensive workings of the Union Quartz mine were made in the past on the north 40 acres of this property. However, these show that little stoping has been done. At one locality, the north center part of the property, it is reported that $50,000 in gold was recovered from pocket occurrences. The amount recovered in placer operations on the east side of the north 20 acres alone is not known.

On the north-central portion of the Honey Bee property, the Union vein has been drifted on for a distance of 250 ft. The vein and shear zone strike N. 24° E., dip 65° NW. and are 4 to 5 feet wide. A 30-ft. shaft has been sunk near the portal of the drift. High on the slope, near the SW. corner of the N. 40 acres, this vein is intersected by a 70-ft. cross-cut tunnel and drifted on 40 feet. In all of these workings the vein and shear zone have about the same attitude but to the north the width is less. In the most southern tunnel, the hanging-wall vein is 3 to 4 inches wide and the sheared rock 18 inches. Here, the zone lies in the hornblende-quartz-diorite.

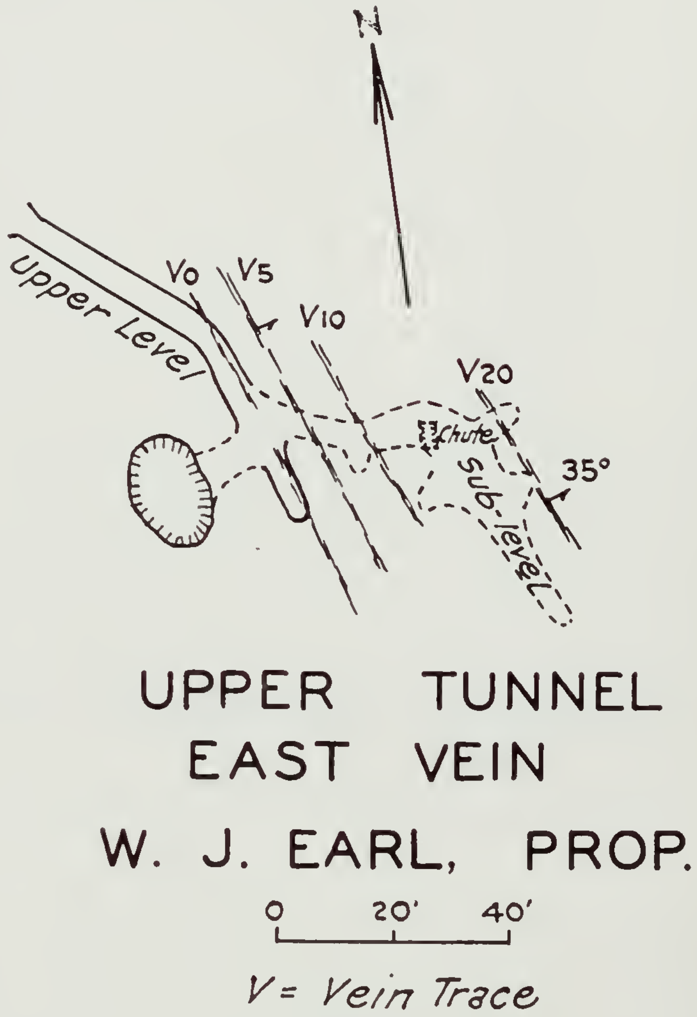

Fig. 9

At a distance of 180 ft., the 500-ft. cross-cut tunnel intersects a six-inch vein of N. 25° E. strike and 60° NW. dip, which is unaccompanied by a wide zone of sheared wall rock.

On the east portion of the property, two tunnels are connected by vertical workings. The lower tunnel is over 250 ft. in length and does not intersect any important veins. An upper tunnel cross-cuts 40 ft. to a vein, which strikes N. 20° W. and dips around 35° to the NE. From the upper tunnel, the vein has been sunk on for 10 ft. to 15 ft. and a sub-level drift runs S. 40 ft. Below the sub-level, a connection is made with the level below and the vein has been sunk on at two places. At another place, it has been raised on a short distance above the sub-level. Above the uppermost level, the vein is reported stoped to the surface at one place. The vein or mineralized zone consists of a 3 to 6-inch quartz vein on the hanging wall, and a foot to 18 inches of sheared biotite-quartz-diorite on the footwall side. On the surface, road-cuts show two small veins that belong to the above vein system and have the same attitude.

A short cross-cut tunnel is reported to intersect a ledge running N. 38° E. near the eastern boundary of the property. Also, a nearly parallel vein is reported farther to the east.

In the ravine, near the center of the N. 40 acres, a 40-ft. cross-cut tunnel intersects the Cross vein, which is supposed to intersect the

Union vein on the property. Immediately south of the tunnel, a two-compartment inclined shaft has been sunk on the vein to a depth of 15 ft.

On Earl's triangular fraction, two short cross-cut tunnels expose a vein ranging up to a foot in width and striking N. 10° W. with nearly vertical dip.

Honey Lake Gold Mines has done a large amount of work at the property formerly known as the *Badger Group* in Sec. 32, T. 27 N., R. 15 E. E. Christiansen, United Nevada Bank Building, Reno, Nevada, is president of the corporation. The property has recently been purchased at a bankruptcy sale by Ralph Wittenberg, United Nevada Bank Building, Reno, Nevada. Fourteen claims are now held. The mine was idle at time of visit and a few notes were obtained from H. Sundberg, who was in charge for Honey Lake Gold Mines, and who is manager for Wittenberg.

At the time of our former report, in 1929, a fissure vein 5 ft. wide in granite, striking S. 32° W. and dipping 70° E., was being developed. It was opened by two tunnel levels, the upper being 80 ft. below the outcrop and 160 ft. long. The second tunnel was 100 ft. lower and was 430 ft. long. Of these lengths 70 ft. in the upper tunnel and 250 ft. in the lower tunnel were on the vein. An ore-shoot, 70 ft. long and 18 inches wide, was exposed in the upper tunnel, and the ore was said to run $30 per ton in gold and silver. The lower tunnel was being driven to reach the ore-shoot at that time.

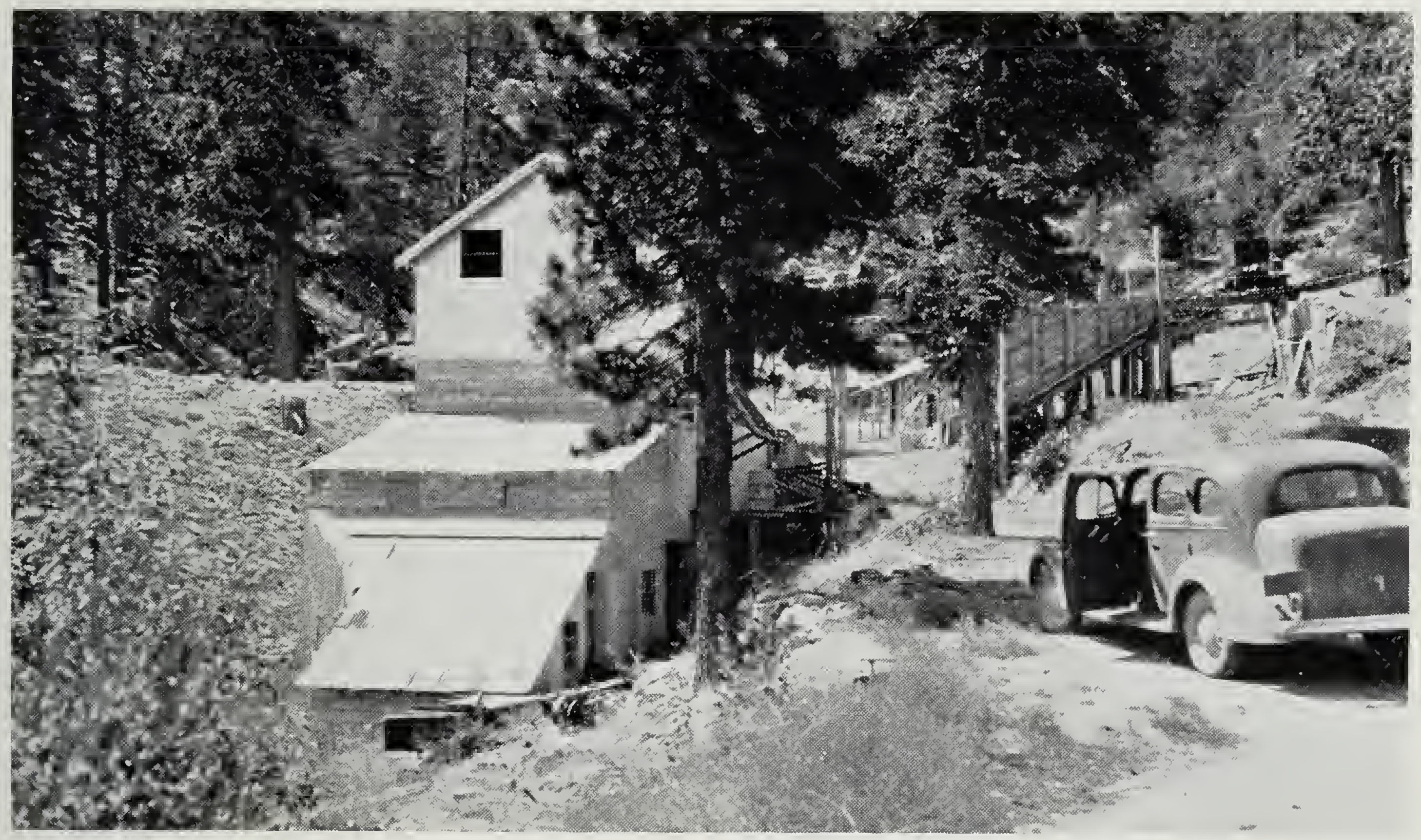

FIG. 10. Mill of Honey Lake Gold Mines

Since the report cited above was made a new tunnel has been driven at an elevation of 523 ft. vertically below the lower of the former tunnels to a length of 2732 ft. No ore has been found on this level but at a 1400-ft. point a 328-ft. raise was put up and 300 ft. of drifting was done at the top. This developed an ore-shoot 100 ft. long and 30 inches wide. The property is equipped with a 10-stamp Straub mill in which treatment is by amalgamation, followed by concentration on a Wilfley table. The road from the highway to the millsite has been completed. It is three miles long at an average grade of 12 per cent.

Bibl: State Mineralogist's Report XXV, pp. 5, 6.

Juniper Mine is a single patented claim in the Hayden Hill Mining District, Sec. 36, T. 37 N., R. 9 E. It has been taken over by *Hayden Hill Gold Corporation*, which see above. In 1934 it was leased to H. P. Anderson, F. H. Brown and George H. Harper, of Adin, who were shipping a carload (40 tons) of very good ore every two weeks to the Selby Smelter. A shaft said to be 400 ft. deep had been cleaned out to the 100-ft level. At the 70-ft. level, the lessees drove 30 ft. of new drift and located a swell in the vein that had been missed by former operators. This showed widths of 6 ft. and 7 ft., and the ore was mined from that width down to a width of one foot. Strike is south 55° E. and dip 70° to 80° to the northeast where the mining was done, but it probably flattens below.

Most of the ore at Hayden Hill consists of free gold in gouge and ochre seams occurring in a volcanic series of rhyolitic tuffs and breccias. This vein at the Juniper, however, contains considerable quartz and some chalcedony, which is said always to give a good assay, but the mud-seams with oxides of iron and manganese contain free gold also. Widths given above are those of the entire shear-zone. The quartz may occur in only a fraction of these widths or in irregular bunches.

Bibl: State Mineralogist's Report XV, p. 233; XIII, p. 201; XII, p. 150; IX, p. 212.

Lassen Lumber and Box Co. In the N½ and SW¼ of the NE¼ of Sec. 35, T. 29 N., R. 11 E., the Lassen Lumber & Box Co., of Susanville, California, holds timber land which has mineral showings.

On the divide between the east fork of Gold Run Creek and a branch to the north, a vein and shear zone 4 ft. to 6 ft. wide strikes N. 10°-20° E. and dips vertically. Surface cuts show a fractured, ocher-stained quartz and silicified wall rock breccia. The walls are semi-decomposed medium to fine-grained hornblende-quartz-diorite. This vein has been regarded as the southern extension of the Gold Belt. Although it generally lines in with it, intermediate croppings are so lacking as to make this point uncertain. As an exception to the rule, this vein was the strongest and best appearing vein that was observed in the finer quartz diorite, and the height of the country in this vicinity may account for it.

Following in a nearly E.-W. direction down the west slope of the hill occupied by the section corner of Secs. 25, 26, 35 and 36, T. 29 N., R. 11 E., is a line of discontinuous outcrops of iron-oxide gossan. These are believed to be iron-rich magmatic segregations in the hornblende-quartz-diorite. At one cropping a 90-ft. shaft has been sunk in a closed area of gossan. This is composed mainly of limonite, decomposed feldspar and sericite. A black oxide shows at depth.

MacThomas property. Mr. M. MacThomas, Susanville, California, holds two parcels of land. One consists of two fractional claims on the NE¼ of the NW¼ of Sec. 25, T. 29 N., R. 11 E.; the other of 160 acres of land designated by the SE¼ of the NE¼ of Sec. 23, in the same township.

On the Jiggs No. 1 claim, a cross-cut tunnel has been driven 167 ft. in a southeasterly direction. This intersects a small vein and it is reported that it should intersect a more prominent vein striking northeasterly about 40 ft. from the present face. Fine grained quartz-diorite is the wall rock.

On the 160-acre parcel of land, the owner reports two veins which are 4 ft. to 5 ft. wide, strike northerly and cut the granitic rock, gravels and andesite lava. However, they are not exposed on the surface. The existence of these veins is entirely unlikely since no vein can cut rocks of such radically different ages. Presumably any veins on this property would occur entirely in the biotite-quartz-diorite country rock.

McDow Property. The property of George N. McDow, Susanville, California, is the largest holding of mineral land in the Diamond Mt. mining district. This consists of two unpatented mining claims and fractions of 30 acres and about 1400 acres of patented mineral land. All of the land lies within the southeast quarter of T. 29 N., R. 11 E., M. D. M., on the north slope of the Sierra Nevada, in Lassen County, California.

Beginning at an early date, most of the land was recognized as being of potential mineral value. However, because of the heavy stand of timber it supported, lumbering operations were carried on first. The earliest mining operation was the placering of Recent gravels at several places on the property. No important gold-bearing veins were found that contributed the placer, and lode development moved forth rather slowly. The surface indications of several wide and persistent veins of potential mineral value eventually led to the driving of a number of tunnels and in a few places small bunches of ore were recovered. Present conditions seem to show, however, that no extensive mining was carried on. Feeling that the conditions warranted development, the Diamond Mt. Mines Co. recently organized for the purpose. Although the company operated a short time, as yet no commercial orebodies have been developed.

The more important veins on the McDow property are the Gold Belt, Tiger, Arrowhead and Boyd. These lie largely within the biotite-quartz-diorite as do most of the important veins in the district, and they are wide and persistent in strike.

At present, the Gold Belt vein is intersected by a 180-ft. cross-cut tunnel and drifted on for nearly 300 ft., at the north end of the Gold Belt claim. The drift and two angle cross-cuts show vein filling to be a wide zone of highly altered and sheared granitic rock which has been silicified, giving quartz veins, stringers and silicified wall rock between biotite-quartz-diorite walls. The width is variable with 10 to 12 ft. a usual maximum. At one place underground, the vein filling appears to be nearly 30 ft. wide but this may be due to faulting. The average strike is around N. 20° E. and the dip is vertical or steep to the northwest.

Natural croppings, cuts, and one shaft expose the Gold Belt vein on the surface for nearly a mile. The gangue is usually a highly fractured and ochre-stained quartz and it contains numerous cavities which

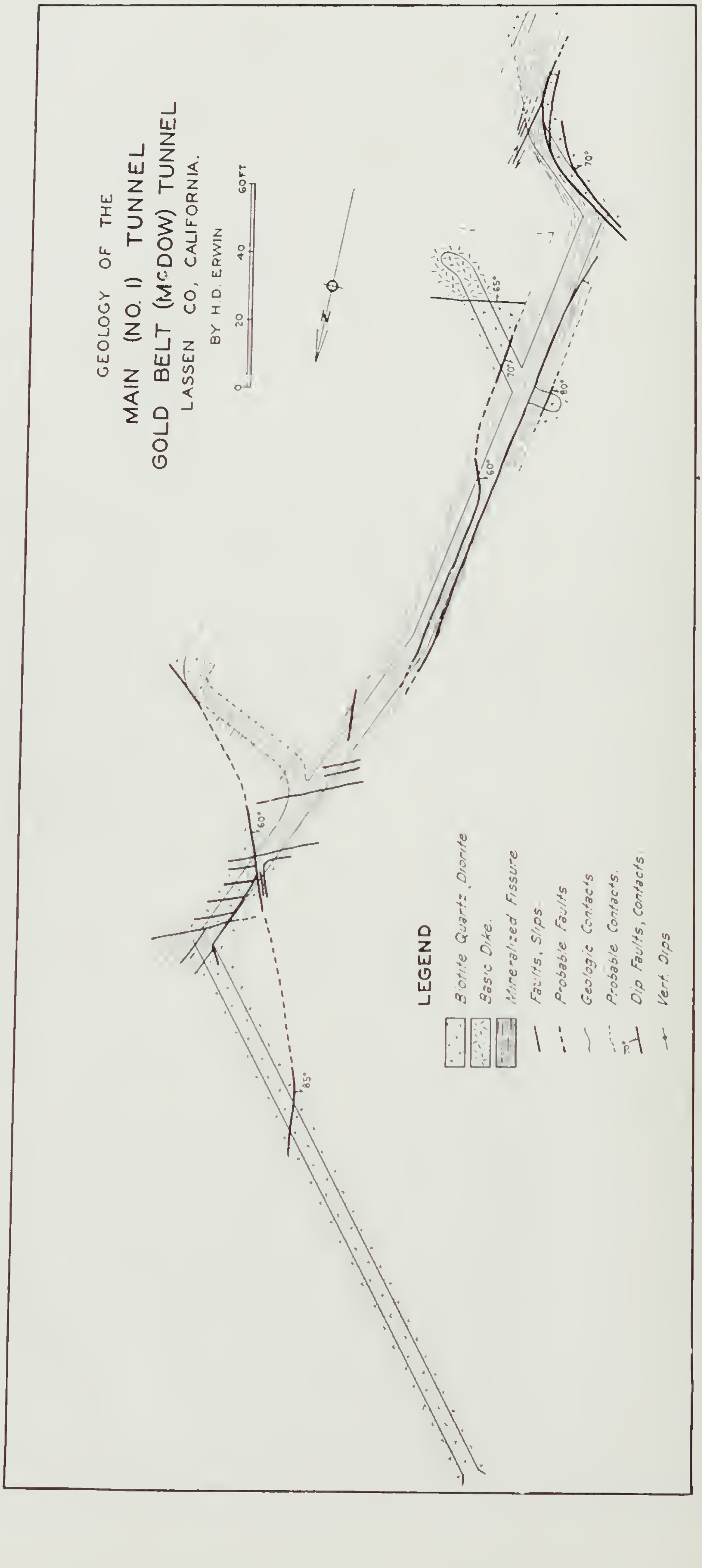
GEOLOGY OF THE
MAIN (NO. 1) TUNNEL
GOLD BELT (McDOW) TUNNEL
LASSEN CO, CALIFORNIA.
BY H.D. ERWIN
0
20
40
60FT
N
70°
65°
70°
80°
60°
60°
85°
LEGEND
Biotite Quartz Diorite
Basic Dike.
Mineralized Fissure
Faults, Slips
Probable Faults
Geologic Contacts
Probable Contacts.
Dip Faults, Contacts
70
Vert. Dips

Fig. 11

are lined with small inward-projecting quartz crystals giving a drusy surface. Brecciated portions of the filling show fragments of wall rock with partial deposition of quartz in the interstitial space, giving a coalescence of drusy cavities. Underground, ochre is not so common and the vein filling takes on white, gray and bluish tones. Fine crystalline pyrite occurs in patches in the quartz and on cavity linings. A complication of post-vein fault movements has occurred along the walls and within the vein to give granulated quartz and pasty gouge matter. Of most concern in the development of the property are several transverse (cross) faults which offset the vein in at least three places. (See Plate I.) The shear-zone and vein cut both acidic (aplite) and basic dikes which intrude the parent granitic rock. The geologic relations in the main tunnel are shown in Figure 11 (see p. 438).

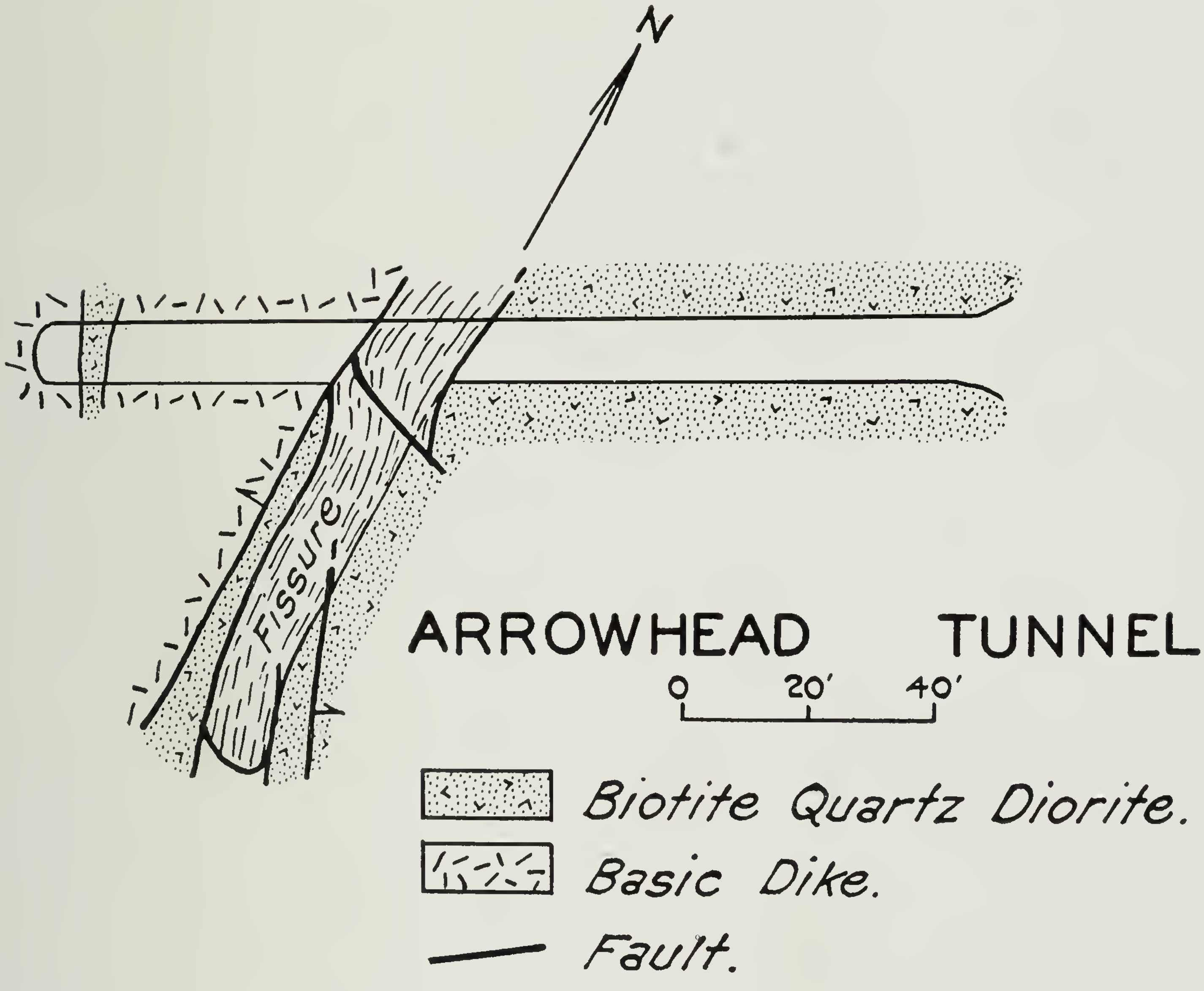

Fig. 12

A faulted segment of the Gold Belt vein, near the south end of the claim is intersected by a 50-ft. cross-cut and drifted on for 40 feet.

The Tiger vein on the Tiger claim is intersected at the discovery point by a 30-ft. cross-cut tunnel. Numerous pits show the surface exposure of this vein on the south half of the claim. The vein and shear-zone is similar in all respects to the Gold Belt except that it may not be as wide (3 to 5 feet) and, perhaps, somewhat less persistent along the strike. To the north, it appears to be off-set by a cross fault and is less evident. (See Plate I.)

The Arrowhead vein, lying west of the Tiger vein nearly a quarter of a mile, is intersected by a 45-ft. cross-cut tunnel and drifted on for 40 feet. The vein strikes N. 4° W. and dips steeply to the west. The shear zone is from 4 to 8 ft. in width and is composed of grey or blue grey silicified wall rock between a large altered basic dike on the hanging wall and semi-decomposed biotite-quartz-diorite on the footwall. The quartz carries scattered patches of fine crystalline pyrite and runs several dollars in gold per ton. Partial oxidation along fractures gives a brown staining. On the surface, the Arrowhead vein is shown by natural croppings and surface cuts. The quartz is ochre-stained and fractured, and drusy cavities are not common. The north-south continuation is undetermined as a capping of old gravels covers it; however, it is regarded as being rather persistent.

Intersecting at a slight angle (N. 10° E.) with Arrowhead is a rather poorly exposed 'east' Arrowhead vein. Much gouge accompanies it as shown by white clay exposures and it controls the seepage of water at several places along the strike.

The northern extension of the Boyd vein is exposed on the McDow property. Consistent with its normal attitude; it strikes in a N. 51° E. direction with steep dip (80°) to the SE. It is exposed by several surface cuts and one short cross-cut tunnel and intersects with the Gold Belt vein to the south near the contact of the two principal granitic rocks (see plate II).

The northern extensions of the Gold Belt, Tiger, Arrowhead veins and other less important veins are little exposed, but a few scattered natural croppings and shallow pits show their presence. The growth of water-seeking willows near surface water courses due to fissuring, has been used as a guide for location of some veins by prospectors. However, this cannot be relied upon for accuracy as other conditions control the growth of these plants.

Three cross-ledges strike about W., and cut the biotite-quartz-diorite between the Arrowhead veins and the Tiger vein and possibly intersect them. Surface exposures are poor. One is composed of apparently valueless massive white quartz. However, the intersection of these veins with mineral-bearing veins may be significant.

Extending in a N. 78° W. strike through the center of Sec. 26 is a quartz vein of 3 to 4 ft. width and vertical dip. It is reported to extend across Gold Run canyon and to be the same vein which outcrops on the west side of the canyon. It cuts both granitic rocks but is probably narrower in the finer quartz diorite. West of Gold Run a small branch vein running E-W is supposed to intersect it.

Immediately SSW. of the center of Sec. 26 is a small vein about one foot in width which strikes N. 11° E. and dips vertically. This vein is in a small body of biotite-quartz-diorite which is surrounded by finer hornblende-quartz-diorite.

In the NE¼ of the SE¼ of Sec. 26, a quartz vein striking N. 59° W. cuts the finer grained diorite. The quartz is massive, white, glassy, and slightly ocher-stained.

In the SE¼ of the SW¼ of Sec. 25, a quartz vein strikes N. 12° W. and dips vertically in hornblende-quartz-diorite. Quartz is white, massive, and clear. The occurrence of alkali feldspar and biotite seem to indicate a rather high temperature condition of formation, which is not favorable for the occurrence of gold.

Bibl: (Gold Belt) State Mineralogist's Reports XXV, p. 7; XV, p. 236; XII, p. 149; X, p. 274.

Neff Brothers' property. Delmar and Harry Neff own forty acres of land comprising the NW¼ of the SW¼ of Sec. 19. Several surface cuts have been made on a small vein and sheer zone which strikes across from Earl's property in a N. 35° E. direction. In past years, extensive placer mining has been done on recent gravels which are reworked portions of old channel gravels.

Red River Lumber Co. Few quartz veins of any importance were found on the timber land holdings of the Red River Lumber Co., Westwood, California. Most of the land is located in an area of prevailing finer-grained quartz-diorite, which has generally not been host to many favorable mineral-bearing veins in the Diamond Mountain region.

Several conspicuous veins do occur; however, all are composed of white glassy quartz and are seemingly unimportant for economically valuable mineral.

In past years, some extensive placer mining has been done on this land. Large hydraulic pits at one place on the Hill creek-Lassen creek divide show operations on a remnant of the old stream channel.

Ridenour property. S. D. Ridenour, Susanville, California, owns a large tract of agricultural land comprising parts of Secs. 17, 18, 19 and 20, T. 29 N., R. 12 E., M. D. M., part of which is of mineral value.

The only important lode mine development on this property to date is the Lone Pine mine. This is situated near the NE. corner of the NW¼ of the NW¼ of Sec. 19, T. 29 N., R. 12 E. Shortly before the year 1900 work for a short period consisted of sinking a 110-ft. two compartment shaft with 70 to 80 ft. of drift south and 10 ft. north on the 100-ft. level. The vein is from 3 to 5 ft. in width, strikes N. 36° E. and has a vertical dip. The gangue is an ochre-stained sugary quartz containing some drusy vugs and cavities. Mr. C. A. Odett, Susanville, reports that the only production was about 200 ounces of amalgam from the rock taken only from the development workings. The gold could not be seen in the rock and no sulphides were reported.

In addition to this deposit, several other gold-bearing veins are reported on the Ridenour property. They occur on or near the ridge in the SW¼ of the NW¼ of Sec. 19.

Satica property is largely in Sec. 24, T. 29 N., R. 11 E. Michel and Robert Satica of Susanville, California, own a large tract of land which contains a number of mineral-bearing veins. As the land is flat and over-burden is thick, the veins have been exposed largely by shaft sinking. Although good gold values are reported, on no part of the property have mining operations been carried on.

Along the north boundary of the property at the edge of the mountain slope, several veins occur. On the north part of the NW¼ of the SW¼ of Sec. 24 a vein from 2 to 3 ft. wide outcrops in a series of cuts. A shallow two-compartment shaft was sunk at one point. The strike of the vein is N. 20° E. and the dip is vertical. The quartz is similar to that of the Gold Belt vein.

North of the Yellow Hammer claim, a short distance, in the NW¼ of the SE¼ of Sec. 24, an old cross-cut tunnel is reported to intersect a vein.

In the SE¼ of the NE¼ of Sec. 24, the 500-ft. cross-cut tunnel of the old Union mine intersects the Union vein at 100 ft. The vein has been drifted on 20 ft. each way from the cross-cut and a winze has been sunk 60 ft. on a 60° incline. The maximum width of the mineralized zone is 10 ft. between walls. Strike is N. 23° E. and dip 60°–70° to NW. Usually, a six-inch vein lies on the hanging wall with sheared quartz-diorite and stringers making up the footwall portion.

On the SW¼ of the NW¼ of Section 24 a two-compartment inclined shaft has been sunk 22 ft. on a prominent vein. The strike is N. 30°–40° E. and dip from 40° to 60° NW. The width between walls is reported to be 11 ft. On the shaft dump, a greyish quartz and silicified wall rock carrying fine pyrite, and gold is reported. Much gouge indicates some intense movement along the walls of the mineral zone. This vein is regarded as the north extension of the Gold Belt vein, which is probably offset by a transverse fault at the foot of the hills to the south. However, it is quite different in dip from the Gold Belt. (See State Mineralogist's Report XXV, p. 9.)

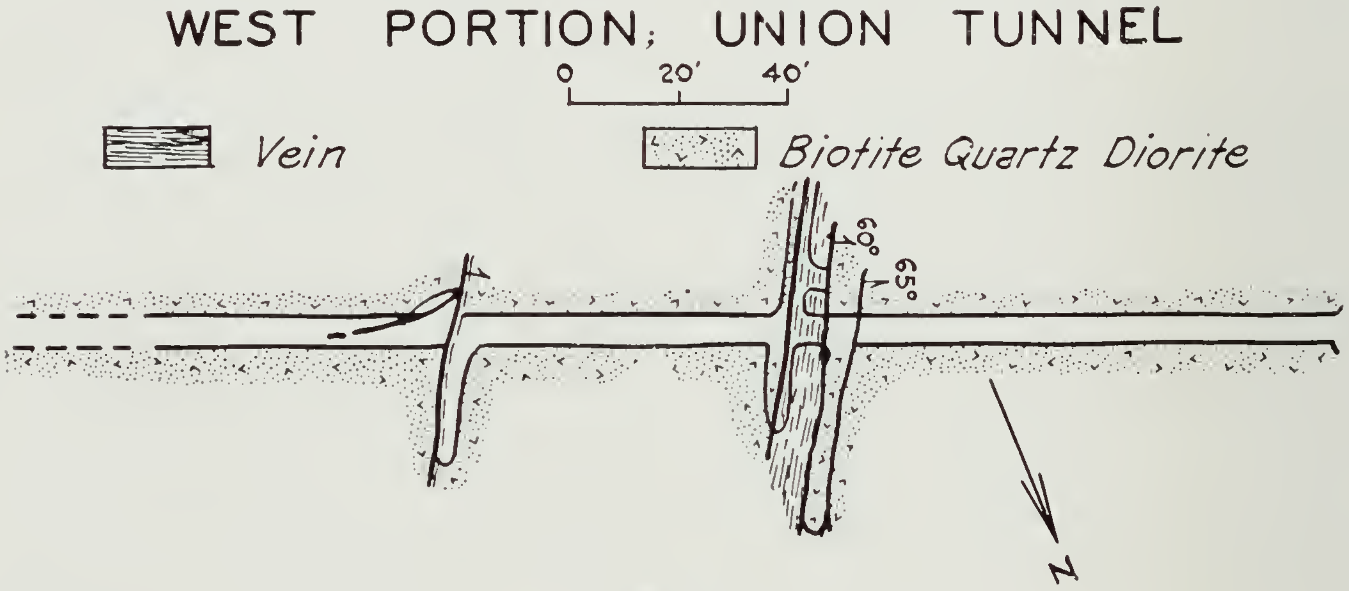

FIG. 13

On the SE¼ of the NW¼ of Sec. 24, two veins strike in a N. 80° E. direction and dip vertically. On the more southerly of these, a two-compartment shaft has been sunk 20 ft. on a one to two-foot vein of fractured, ocher-stained quartz. Branch stringers are reported present. Several hundred yards to the north, a second vein from 3 to 4 ft. wide is composed of ocher-stained, fractured vuggy quartz of granular texture.

Near the NE. corner of the NE¼ of the NE¼ of Section 24, a two-compartment shaft has been sunk to a shallow depth. The vein matter is similar to and parallel to the Lone Pine vein, a short distance to the east. Immediately south of the shaft, a WNW. striking high-grade vein about a foot wide is reported.

Bibl: State Mineralogist's Report XXV, p. 9.

Watson estate. Near the summit of the Hill creek-Lassen creek divide, on the west center portion of Sec. 29, T. 29 N., R. 12 E., M. D. M., several large veins occur on the property of the George Watson estate.

Natural croppings show at least three wide veins. Although they occur in the biotite-quartz-diorite, which is host to favorable deposits to the west, these veins do not appear favorable at the surface. They are composed of white, clear glassy quartz and pink orthoclase feldspar, and limonite staining is absent. The widths are variable, running up to 15 ft. and 20 ft. One strikes N. 70° W., another N. 75° E. and a third N. 10° E. All dip probably vertically. The veins striking nearly east-west contain the feldspar and are regarded as pegmatite veins. They grade from pegmatite to quartz veins in less than 1000 ft. on the surface. The occurrence of gold in these seems unlikely.

Webster Fraction. Mr. Henry Webster, Santa Cruz, California, holds a triangular fraction of unpatented land immediately east of the NE. corner of the Gold Belt claim. An east tunnel cross-cuts 70 ft. to a vein several inches wide and drifts a short distance south. The strike is N. 7° W. and the quartz is ocher-stained with acompanying sheared quartz-diorite wall rock. The dip is 85° to the SW. A west tunnel was caved at the time of visit but a series of pits on the surface indicates that it must intersect a one-foot vein which strikes N. 50° E. toward the Gold Belt claim and which dips nearly vertically.

MINERAL SPRINGS

The following mineral springs have been described in more detail by Tucker[1] and by Waring[2] and analyses of the water have been made for many of them. These will be found in the references given.

Amedee Hot Springs are at Amedee in Honey Lake Valley. The water is saline, and the temparature is 172° to 204° F.

Bassett Hot Spring is 2½ miles east of Bieber in Big Valley. A sulphate water flows at a rate of 175 gallons per minute. The temperature is 173° F.

Highrock Springs is 10 miles southeast of Amedee. The flow is 525 gallons per minute, and the water is used for irrigation.

Shaffer Hot Springs are at Hot Springs Station on the Nevada, California and Oregon Railroad (now Southern Pacific). Temperature is 204° F.

Stone Breaker Hot Springs are eight miles southeast of Bieber in Big Valley. Temperature is 165° F.

STONE INDUSTRY

Lassen County is in a region largely covered by lavas, and a very large number of places are available where lavas and tuffs can be quarried. Granitic rocks are available along the southern county line. The following quarries have produced commercially as noted:

Burroughs and Raker Quarry is owned by Mrs. Gladys Burroughs and Mrs. Ivy Raker, of Susanville, and is located in Sec. 31, T. 30 N., R. 12 E., on the edge of the town of Susanville. The gymnasium of the high school at Susanville and the court house at Susanville are faced with this stone, which is a rhyolitic tuff.

Greig Quarry. In the NW¼ of the SW¼ of Sec. 18, T. 29 N., R. 12 E., M. D. M. there is a small stone quarry in the biotite-quartz-diorite. This lies on the north slope of Gold Run Valley and is about five miles south of Susanville. James Greig, Susanville, is owner. Operations have been small and recovery to date has been largely for monumental stone.

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[1] Tucker, W. B., Report XV of the State Mineralogist, p. 236.
[2] Waring, G. A., U. S. Geol. Survey, Water Supply Paper 338.

Bibl: State Mineralogist's Report XXV, p. 9, Jan. 1929.

Nolan Quarry. Mrs. William J. Nolan, Merriam Apartments, 1017 14th Street, Sacramento, California, holds some land in Sec. 6 (?), T. 29 N., R. 11 E., seven miles west of Susanville on the Red Bluff-Susanville highway, from which thousands of cubic yards of basaltic lava have recently been quarried as road metal for use with an oil binder on this hard-surfaced highway. The lava is some 30 or 40 feet thick and overlies what is apparently an old river channel containing deposits of sand and rounded pebbles and boulders, all of which have apparently been derived from volcanic rocks of various kinds.

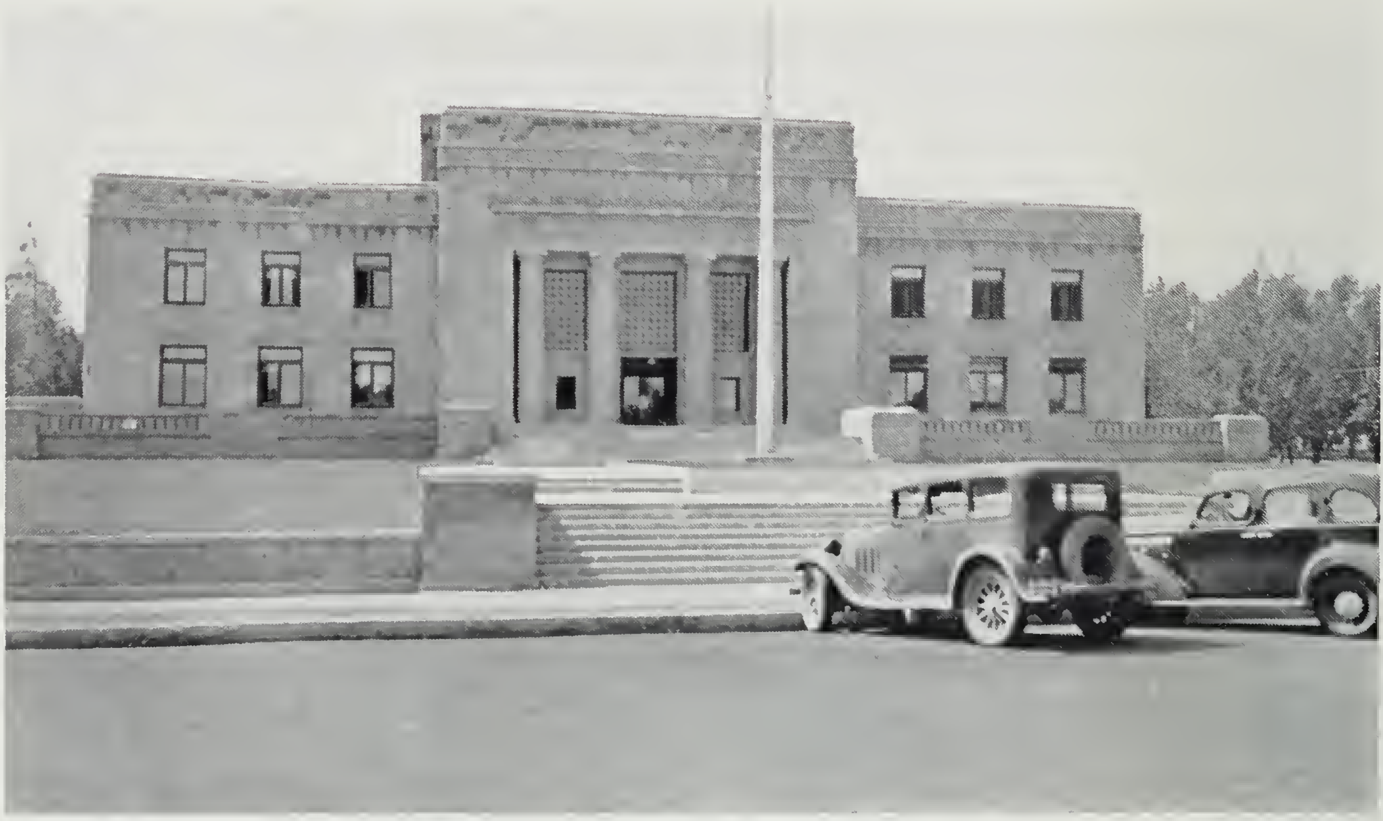


FIG. 14. Courthouse, Susanville, faced with rhyolitic tuff from Burroughs & Baker Quarry

MINERAL RESOURCES OF MODOC COUNTY

CHAS. VOLNEY AVERILL, District Mining Engineer

Geography.

Modoc County is located in the extreme northeastern corner of the state, with the state of Oregon adjoining to the north, and the state of Nevada to the east. By the census of 1930, the population is 8000 persons, of which 2300 live at Alturas, the county seat. A small part of the Modoc Lava Beds National Monument is in Modoc County, but the bulk of it is just to the west in Siskiyou County. A tract of about 75 square miles within the National Forest has been set aside because of the interesting volcanic formations, including lava vents and pipes, also caves containing ice, in which the bones of animals have been embedded for many centuries. Writings of some ancient race of Indians are found carved in the rocks of these caves and in the rocks on the shore of Tule Lake nearby.

Topography.

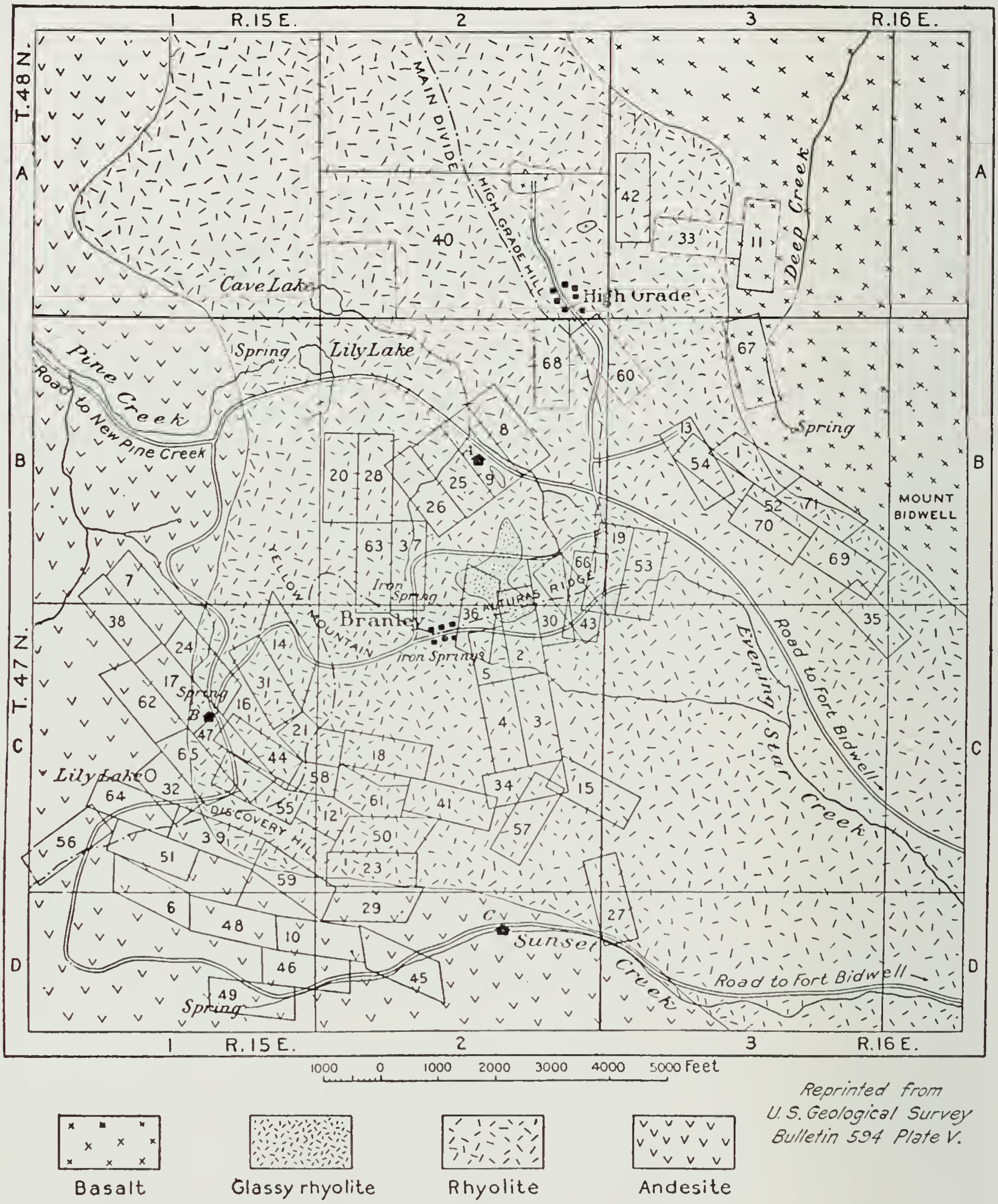
Plateaus and rolling hills at elevations of 4000 feet to 6000 feet are characteristic of most of Modoc County. Forest covers these in large part, and with the Warner Mountains they make up the Modoc National Forest. The Warner Mountains rise to a maximum elevation of nearly 10,000 feet, and trend in a northerly and southerly direction across the entire eastern end of the county. Surprise Valley, a belt of nearly level land with the same trend as the mountains, extends from their base to the Nevada state line. The elevation of this valley is 4700 feet. A chain of shallow lakes, which become dry in the summer, occupies a large part of the area of this valley. Along the northern boundary of the county are similar lakes, such as Goose Lake and Tule Lake, which extend into Oregon. Pit River drains the hills and plateaus west of the Warner Mountains, while the eastern slope of the mountains drains into the shallow lakes of Surprise Valley.

Climate.

The four distinct seasons of a typical mountain climate bring a large number of dry, clear days. The summer temperature rarely rises above 90° F., but zero weather and below must be expected in the winter. Snow covers the higher portions for many months of the year; but it melts quickly in the valleys. The annual precipitation is 14 inches at lower elevations, but is greater in the mountains.

Industries.

Stock raising is the leading industry of the county, and lumbering is to be noted. Farming is important, and some dry farming is done, but for good results irrigation must be used. Large herds of cattle of beef breeds, dairy stock, sheep, horses and mules are raised. All kinds of hay, including alfalfa, are grown, and there is an important production of alfalfa seed. Oats, wheat, barley, rye, deciduous fruits and sugar beets are produced. A number of storage reservoirs have been built, and 200,000 acres of land are under irrigation. In Surprise and Goose Lake valleys, good flows of water are obtained from artesian wells.


R.15 E.
R.16 E.
T.48 N.
T.47 N.
1
2
3
A
B
C
D
MAIN DIVIDE
HIGH GRADE HILL
High Grade
Cave Lake
Lily Lake
Spring
Pine Creek
Road to New Pine Creek
Deep Creek
MOUNT BIDWELL
YELLOW MOUNTAIN
Iron Spring
Branley
ALTURAS RIDGE
Iron Springs
Evening Star Creek
Road to Fort Bidwell
Lily Lake
DISCOVERY HILL
Sunset Creek
Road to Fort Bidwell
1000 0 1000 2000 3000 4000 5000 Feet
Basalt
Glassy rhyolite
Rhyolite
Andesite

Reprinted from U. S. Geological Survey Bulletin 594 Plate V.

FIG. 1. SKETCH MAP OF HIGH GRADE MINING DISTRICT, MODOC COUNTY, CAL.

Merchantable timber amounts to 3½ billion feet in national forests and 6½ billion feet privately owned. Western yellow pine comprises 75% of this. A large sawmill was built at Alturas a few years ago, but it has not yet been put in operation. Smaller sawmills are, however, in operation in other parts of the county.

MINERAL PRODUCTION OF MODOC COUNTY, 1880-1934

Year	Gold, value	Silver, value	Salt		Miscellaneous stone[1], value	Miscellaneous and unapportioned		
			Tons	Value		Amount	Value	Substance
1880	$10,000	--------	--------	--------	--------	--------	--------	
1881	20,000	$1,500	--------	--------	--------	--------	--------	
1882	--------	--------	--------	--------	--------	--------	--------	
1883	50,000	--------	--------	--------	--------	--------	--------	
1884	60,000	--------	--------	--------	--------	--------	--------	
1885	60,000	--------	--------	--------	--------	--------	--------	
1886	--------	--------	--------	--------	--------	--------	--------	
1909	[2]	--------	--------	--------	--------	--------	--------	
1910	5,438	75	--------	--------	--------	--------	--------	
1911	19 875	363	--------	--------	--------	--------	--------	
1912	27,893	494	50	$800	--------	--------	--------	
1913	6.061	94	40	720	--------	--------	--------	
1914	1,000	10	40	720	--------	--------	--------	
1915	7,557	104	[3]	--------	$300	--------	$720	Other minerals.
1916	2,729	90	[3]	--------	200	--------	540	Other minerals.
1917	--------	--------	--------	--------	200	--------	--------	
1918	[3]	[3]	[3]	--------	200	--------	8,020	Gold, salt, silver.
1919	6.478	390	[3]	--------	550	--------	1,802	Other minerals.
1920	[3]	[3]	[3]	--------	700	--------	3,968	Gem material (Iceland Spar) gold, salt, silver.
1921	--------	--------	[3]	--------	34,93	--------	1,720	Gem material (Iceland Spar) and salt.
1922	--------	--------	[3]	--------	[3]	--------	16,018	Salt, miscellaneous stone.
1923	[3]	[3]	[3]	--------	8,109	--------	288	Gold, silver.
1924	--------	--------	[3]	--------	[3]	--------	1,300	Salt, miscellaneous stone.
1925	--------	--------	--------	--------	--------	--------	2,400	Salt, miscellaneous stone.
1926	158	[3]	--------	--------	36,450	--------	1,380	Other minerals.
1927	--------	--------	--------	--------	61,651	--------	600	Other minerals.
1928	--------	--------	--------	--------	29,440	--------	1,000	Other minerals.
1929	--------	--------	--------	--------	30,346	--------	650	Other minerals.
1930	--------	--------	[3]	--------	[3]	--------	16,250	Miscellaneous stone and salt.
1931	293	2	--------	--------	180,104	--------	851	Other minerals.
1932	2,082	29	[3]	--------	48,221	--------	670	Gems and salt.
1933	1,346	13	[3]	--------	164,614	--------	774	Other minerals.
1934	6,323	67	[3]	--------	41,150	--------	577	Other minerals.
Totals	$287,233	$3,234	[3]130	$2,240	[3]$637,165	--------	$59,528	

[1] Includes crushed rock, rubble, sand, gravel.
[2] Included under Lassen County production.
[3] See under 'Unapportioned.'

Transportation.

Railroad transportation in the county has been greatly improved in recent years. In addition to the broad-gauge line of the Southern Pacific, which was formerly narrow gauge, crossing the county in a north and south direction near the eastern side, there is now a connecting line running diagonally across the county from Alturas to Klamath Falls. Crossing the county in a north and south direction at its western side is a line of the Great Northern connecting Klamath Falls, Oregon, with the lines of the Western Pacific running along the Feather River canyon. Highways with hard, oil-treated surface cross the county from east to west and from north to south, and other roads reach within a few miles of any point in the county.

Geology and Mineral Deposits.

All of the rocks and mineral deposits of Modoc County are of Tertiary or Quaternary age. These formations are, without question, less favorable to the development of valuable and deep-seated deposits of mineral than the older formations of the Sierra Nevada and the Klamath Mountains. But this may have been over-emphasized, and the common conception of Modoc County as a region of lava beds has perhaps discouraged prospecting. The fact is that some of the Tertiary formations are mineralized. The following descriptions of the two most important districts, the High Grade district, and the Winters district containing the Lost Cabin (Hess) mine, are quoted from Bulletin 594[1] of the United States Geological Survey, now out of print.

"Geology of High Grade District

"GENERAL FEATURES.—The lower 500 feet of the hills immediately east of Goose Lake is made up of purplish and greenish beds of andesite tuffs, which form the walls of Pine Creek canyon for about two miles from its mouth. Overlying these tuffs and dipping east at low angles there is a light buff-colored to white granular rhyolite, which forms the canyon walls to a point about one-fourth mile above the sawmill, where there is a series of dark-brownish soda rhyolite flows, followed by the andesite shown on the left side of the accompanying map, which are the oldest rocks in the vicinity of the mines.

"In the High Grade district proper there are four distinct types of extrusive lavas. The oldest rock exposed along the lower western side of the district (see map) is a dark fine-grained andesite; above this is a white to yellow rhyolite that in some places is tuffaceous, but in most places is finely granular; above this rhyolite on the flat eastward slope of Alturas Ridge (see map) there is a purplish flow rhyolite with very fine lamellae. A fresh porphyritic augite basalt is exposed on the west flanks of Mount Bidwell, and presumably forms the summit of this eminence. Dark obsidian (volcanic glass) covers a small part of the area shown on the map as basalt.

"ANDESITE.—The andesite in the western part of the district (see map) is composed of dark-gray to green flows, dipping east at low angles. All the andesites show distinct flow structure, and some of them are in part glassy. The porphyritic andesite on the south side of Discovery Hill, though the best-preserved rock of this type seen, is much altered. The rather small plagioclase phenocrysts are largely altered to chlorite and some calcite. The groundmass is composed of plagioclase laths and magnetite, the plagioclase being largely altered. All the ferromagnesian minerals are altered beyond recognition. The feldspar crystals in the groundmass distinctly bend around the phenocrysts.

"CONTACT OF ANDESITE WITH RHYOLITE.—On the ridge about two miles west-northwest of High Grade the yellowish rhyolite overlies the andesite. In the valley of Pine Creek the contact is covered by glacial material, but it is probable that it is about at the 6600-foot contour. The contact is again seen about 400 feet below the summit of Discovery Hill, at an elevation of 7700 feet, but in Sunset Creek it lies at an elevation of only 6400 feet. The great difference in elevation of the andesite-rhyolite contact at different places is probably due in the main to faulting, though some of it may possibly be attributed to erosion of the andesite surface prior to the outflow of the rhyolite.

"RHYOLITE.—The rhyolite that forms all of Yellow Mountain and High Grade Hill and the northern part of Discovery Hill is white but weathers yellow. It consists of fine granular quartz and orthoclase, with here and there a very small amount of biotite. On the western slopes of High Grade Hill and Yellow Mountain there is about 200 feet of yellow rhyolite tuff below the granular rock. The majority of the rich veins of the camp are found in this rhyolite.

"GLASSY RHYOLITE.—On Alturas Ridge (see map) there is a small area of thinly laminated purple rhyolite. Under the microscope this rock is seen to be in large part a glass in which there are a few crystals of quartz and orthoclase. Its relation to the granular rhyolite described above was not definitely determined, though it appears to be a down-faulted block and is presumably younger than the granular rhyolite.

"BASALT.—The augite basalt on the west flank of Mount Bidwell, shown in the upper right-hand corner of the map, is a perfectly fresh, greenish-black porphyry that weathers dull brown. The few andesine phenocrysts are quite large and well developed. The groundmass is composed of andesine, pinkish-gray augite, almost colorless olivine, and magnesite, named in the order of decreasing abundance.

"On the road from High Grade to Branley, about one-eighth of a mile south of the Pine Creek-Fort Bidwell road crossing, there is a small exposure of black porphyritic volcanic glass, obsidian, which shows columnar structure. On the map this rock is included with the basalt, though it may have the composition of a rhyolite.

"STRUCTURE.—The various flows described above have a low eastward dip, being part of the tilted fault block that forms the Warner Mountains. The faults along which this block has been raised are on the west side of Surprise Valley and the east side of Goose Lake Valley. Along the Goose Lake Valley fault the vertical movement was relatively greater than along the Surprise Valley fault, which resulted in the monoclinal structure of the region visited. There is some evidence of minor faulting near the summit of the range and it seems probable that there is a rather large fault about three miles east of Goose Lake fracture. No definite evidence of this was seen, as the writer spent most of the available time at the mines. There is, however, a strong suggestion of such a fault in the abrupt rise in Pine Creek canyon at that point and a series of cliffs in the south branch of Pine Creek.

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[1] Hill, J. M., Some mining districts of northeastern California and northwestern Nevada, U. S. Geol. Survey Bull. 594, 1915.

"The Mineralization of the High Grade District took place along the minor fractures near the summit of the range.

"Rock Piles"

"The so-called 'rock piles' of High Grade Hill and the north slope of Discovery Hill are, as the name implies, piles of angular talus blocks up to six feet in longest dimension. A typical example of these is found at the Sunshine tunnel. This talus in some places is 20 feet thick but is usually 5 to 10 feet. The principal veins so far disclosed are near these piles, and prospecting for them is rendered difficult on account of the necessity of moving so much loose material. These accumulations of talus are the result of differential weathering. The rock of which they are composed is highly silicified rhyolite, which weathers much less rapidly than the ordinary unaltered rhyolite. This unequal speed of weathering has resulted in the disintregation of the surrounding softer rhyolite, leaving knobs of the more resistant rock. The action of the freezing of water in the small cracks penetrating the rock has split off the large angular blocks.

"The depressions around the base of some of the piles are to be explained by the fact that much of the disruption of the knobs has taken place when there was deep snow on which the blocks have fallen. When this snow melted it dropped its load in an irregular fashion. In most of the talus piles some unmelted snow can be found throughout the year.

"Evidences of Glaciation

"There was a small glacier in the main fork of Pine Creek between High Grade Hill and Yellow Mountain (see map), which carved the steep north slope on Yellow Mountain and formed the low moraines which have dammed Cave and Lily lakes. The ice did not move far, so that practically all the material in the moraine is angular. There was also a much smaller ice field in the south head of Pine Creek west of Discovery Hill, which formed the basin now occupied by south Lily Lake.

"The glaciation seems to have been restricted to the western side of the Warner Mountains in this vicinity, as there is no evidence of ice erosion in the valleys of either Sunset or Evening Star creeks.

"Ore Deposits

"Types

"There are three rather distinct types of ore deposits in the High Grade district—(1) veins in granular rhyolite, with some replacement of the walls; (2) veins in andesite; (3) veins and replacements in glassy rhyolite. The veins of the kind first named yield the largest amounts of ore. Gold alloyed with some silver is the valuable constituent of the ore and in all places so far opened the gold occurs free. Minor amounts of copper silicate and a little carbonate were seen in the veins in andesite.

"Origin and General Features of the Veins

"The development work in the district consists largely of open cuts and shallow shafts, so it is not possible to draw final conclusions. It appears, however, that the mineralization of all types occurred at about the same time. The solutions came up along fractures partly filled with breccia, especially in the rhyolite areas. The principal veins occur in nearly east-west vertical fissures, though north-south and northwest-southeast fractures are not unknown. The mineralization was accomplished by hot siliceous solutions carrying gold, silver, iron, and potassium, which altered the wall rocks near the fissure by the addition of potassium to form quartz and adularia rock. In practically all the veins postmineral movements have in places crushed the ore and produced gouge, which, though seen in places between the wall and the vein quartz, is commonly found in the quartz where the wall rock was too tough to fracture. The clay gouge of almost every vein constitutes the richest ore, showing a secondary downward concentration of gold from the parts of the veins that have been removed by erosion.

"Veins in Granular Rhyolite

"The veins in granular rhyolite are found on High Grade Hill, on Alturas Ridge, and the north side of Discovery Hill. In all these places the granular rhyolite has been more or less silicified, particularly along zones of brecciation, the result being that the rock has become exceedingly hard. On High Grade and Discovery hills this hard altered rhyolite has weathered into the so-called 'rock piles.' The veins of this type are usually associated with these areas, though there are some veins in unbrecciated rhyolite. In these veins the best ore occurs in shoots which pitch east or southeast on the veins at medium angles. . . .

"Veins in Andesite

"The veins in andesite in the area visited are confined to the south side of Discovery Hill. The andesite is cut by a number of small white quartz stringers, which strike west-northwest and east-northeast and which in some places unite to form fair-sized veins, as on the North Star, Oregon, and Sunset claims. Most of the larger veins strike about N. 60° W. and dip 70°–75° S. Post-mineral movement has formed gouge along the walls and in some places has crushed the veins. . . .

"Veins and Replacements in Glassy Rhyolite

"At the Alturas, a 105-foot vertical shaft is sunk along a north-south fracture cutting glassy flow rhyolite. In some places along this zone there is a little fault breccia, but the fissure is usually quite tight. Pyrite has been deposited as the matrix of the breccia, together with bluish, white, and amethystine quartz, and has also followed the crystalline lamellae of the glassy rhyolite fragments in the breccia as well as in the walls. Pyrite in thin films apparently replaces certain lamellae of the flow rhyolite for 18 feet east of the fissure. This class of ore is said to run about $5 a ton. The value is in gold and the ore above the 50-foot level is said to have been free milling. . . .

"Future of the District

"There can be no question that some of the veins in the High Grade district are superficially rich. All are narrow, as far as known. There are some bodies of replacement ore in the glassy rhyolite, but they are small, and to judge from the Alturas mine the original ore of this class is not of high grade. Pyrite is the only sulphide seen in the region, and it seems probable that the ore below water level, which can not lie very deep, will prove to be relatively low-grade sulphide ore, such as is impracticable to work in many camps. It seems possible, however, that some of the veins will produce considerable gold from ore above the ground-water level."

"Geology of Winters District

"The rocks in the vicinity of the mines are all porphyritic and, with the exception of the cap rock on Shaeffer Mountain and that south of the Adin-Alturas road, were thought in the field to be andesites. The cap rock is a vesicular basalt. The supposed andesite porphyries at the south base of Shaeffer Mountain are gray to brownish gray and are all more or less altered, though the plagioclase phenocrysts are still prominent. Some of the rocks are thin flows, some are distinctly tuffaceous, and a large proportion are rather massive porphyries.

"Under the microscope these rocks are seen to be very similar in composition. The groundmass is usually a mosaic of microscopic crystals of basic plagioclase with magnetite and a ferromagnesian mineral that seems to be augite. In this groundmass, which in all the slides constitutes over half of the mass of the rock, are set small, well-developed crystals of olivine and of basic plagioclase, whose wide extinction angles show it to have nearly the composition of bytownite or labradorite. There are also some rather large irregular granules of magnetite in the rock. The olivines are all partly altered to calcite and serpentine, and in some slides iddingsite is seen in the cracks of the olivines. The feldspars have been largely changed to chlorite and calcite, and the groundmass in all the slides is more or less serpentinized.

"Ore Deposits

"GENERAL FEATURES.—The ore deposits strike west-northwest in a zone of slight displacement along which the flows north of the fault zone have been raised with relation to those south of it. This zone has been traced for about 2 miles east and west and is scarcely more than one-half mile wide. There are in all about 30 claims on which more or less work has been done. Those at the eastern end of the zone are owned by Mr. W. H. Winters, for whom the district is named. Those at the west, with the exception of some claims held by Winters, and the Hess Mine, are controlled by the Dixie Queen Mining Co.

"As there is very little relief along the ore zone the development will of necessity be largely by shafts. There are a few short tunnels, mostly crosscuts in barren rock, and a number of shafts from 20 to 50 feet deep on the veins, but the greater part of the work so far done consists of prospect pits and cuts. The veins exposed are usually small; the widest seen is the Hess, which attains a maximum width of 8 feet.

"CHARACTER OF THE VEINS.—Brecciated country rock is associated with all the ore mined, but at the Hess mine it is not abundant. Sulphide ore was seen only on the 120-foot level of the Hess mine, where a very small amount of pyrite was found.

"The vein filling consists of calcite, largely replaced by quartz and adularia. This replacement process is well shown in a thin section of ore from the 100-foot level of the Hess Mine, in which veinlets of quartz and adularia are seen penetrating calcite along cleavage lines.

"In a thin section of ore from the Dixie Queen claim the same process is shown and also a later development of long needles of gypsum penetrating all three of the original constituents of the ore.

"ORIGIN OF THE VEINS.—These veins were deposited by solutions rich in compounds of calcium and potassium and in silica. The calcium was deposited as calcite first. Later, but probably during the same period of mineralization, solutions that were rich in silica and potassium changed the calcite into quartz and adularia. It is not known when the gold was deposited.

"AGE OF THE DEPOSITS.—Beyond the fact that the veins were formed after the brecciation of Tertiary lavas there is no direct evidence as to the age of these veins, though they do not penetrate the last basaltic flows, which are possibly of

Pleistocene age. However, they are probably to be correlated with 'The late Tertiary epoch' of mineralization of Lindgren.[1]

"HESS MINE.—The only mine that has been developed to any extent, and the one producer of the district, is the Hess, located about one-fourth of a mile east of the Adin-Alturas road, at the head of the south fork of Stone Coal Creek.

"The Hess vein strikes east and dips about 55° S. It occurs along a zone of faulting, which has produced a breccia of basalt 4 to 10 feet wide. In this breccia the vein is 4 to 6 feet wide, consisting of quartz, calcite, and adularia cementing fragments of the wall rock, the latter constituting less than 10 per cent of the ore. This body at the surface is about 80 feet long, at the 120-foot level it is 150 feet long, and at the 150-foot level it is 65 feet long. The inclined shaft is 200 feet deep, at which level the vein, which was 6 feet thick at the 150-foot level, has split into a great number of small, slightly mineralized quartz stringers extending through 20 feet of soft gouge-like crushed basalt.

"The gold, which occurs in very fine particles, is said to be hard to save by amalgamation, but to be easily extracted by the cyanide process. The best ore is said to occur near the footwall, but at the 100-foot level 3 to 4½ feet of good ore was found above the footwall under about 1 foot of lower-grade ore.

"The ore body exposed in the shaft has been at least three-fourths stoped, largely by overhand methods. The stopes are well timbered but open. As yet no new ore has been developed, though it was the intention to prospect the vein east of the main shoot and below the present development.

"Six men are employed at the mine, working two shifts; the hoisting is done by a whim capable of working to a depth of 500 feet."

COPPER

Seitz Copper Mine. Tucker[2] describes this as a series of narrow veins in andesite, located seven miles south of Fort Bidwell. The ore carries cuprite, malachite, azurite, and native copper; and some ore has been shipped from the property. There has been no recent activity here.

GOLD

Blue Bell Group is in Sec. 1, T. 47 N., R. 15 E., and is owned by William R. Larkin, of Alturas. The property consists of three claims lying in a steep, mountainous country at an elevation of 7500 ft.

The deposit consists of quartz veins in rhyolitic breccia. An upper tunnel runs due south for a distance of 100 ft., then turns to run a little south of east for a distance of 87 ft. This latter part is a drift on 2-ft. width of silicified breccia, which assays from $3 to $5 per ton in gold, according to Larkin. (Gold at $20.) The dip is 70° to the south. Another tunnel is 40 ft. lower and 100 ft. to the northwest. It runs south for 90 ft., then turns and runs southeast for 20 ft., following a stringer zone in a fine-grained cream-colored rock, probably rhyolitic. The rock contains a few dark-colored, rounded inclusions that give it the appearance of a breccia. The stringer-zone is 2½ ft. in width, but the best ore is in a quartz stringer from 6 inches to 8 inches in width. The dip of this zone is also 70° south. The vein and the country rock near it contain numerous open cracks, as much as a foot in width. The quartz stringers also contain open seams and cavities into which pointed quartz crystals have grown in comb-structure.

Larkin works alone with hand-tools, sorting this ore and hauling a ton at a time of the sorted ore to the Selby smelter. He states that his shipments of this hand-picked ore have averaged $300 per ton in gold. On the dump are 20 to 30 tons of rejects from the sorting, which he estimates contains roughly $20 per ton in gold.

Craig Property is in Sec. 13, T. 47 N., R. 14 E., at point about three miles east of Willow Ranch, and is being operated by W. H. Craig, Matt Lock and Modrell Bros., all of Willow Ranch, California, and Dr. J. L. Lyon of Lakeview, Oregon. It comprises 484 acres of patented land.

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[1] Lindgren, Waldemar, Metallogenetic epochs: Canadian Min. Inst. Jur. vol. 12, pp. 102–113, 1909.

[2] Tucker, W. B., Report XV of the State Mineralogist, 1915–1916.

The vein is on a contact of an andesite and a breccia, probably rhyolitic. A fracture on the breccia side (the footwall side) of this contact carries considerable vein quartz, also much gouge and iron-oxide that is said to carry gold. From a 100-ft. adit level a 160-ft. incline-winze has been driven on the vein. From this there is 30 ft. of drifting at the bottom, 60 ft. at the 100-ft. level, and 60 ft. at the 50-ft. level. The vein strikes northeast and dips 45° to the southwest.

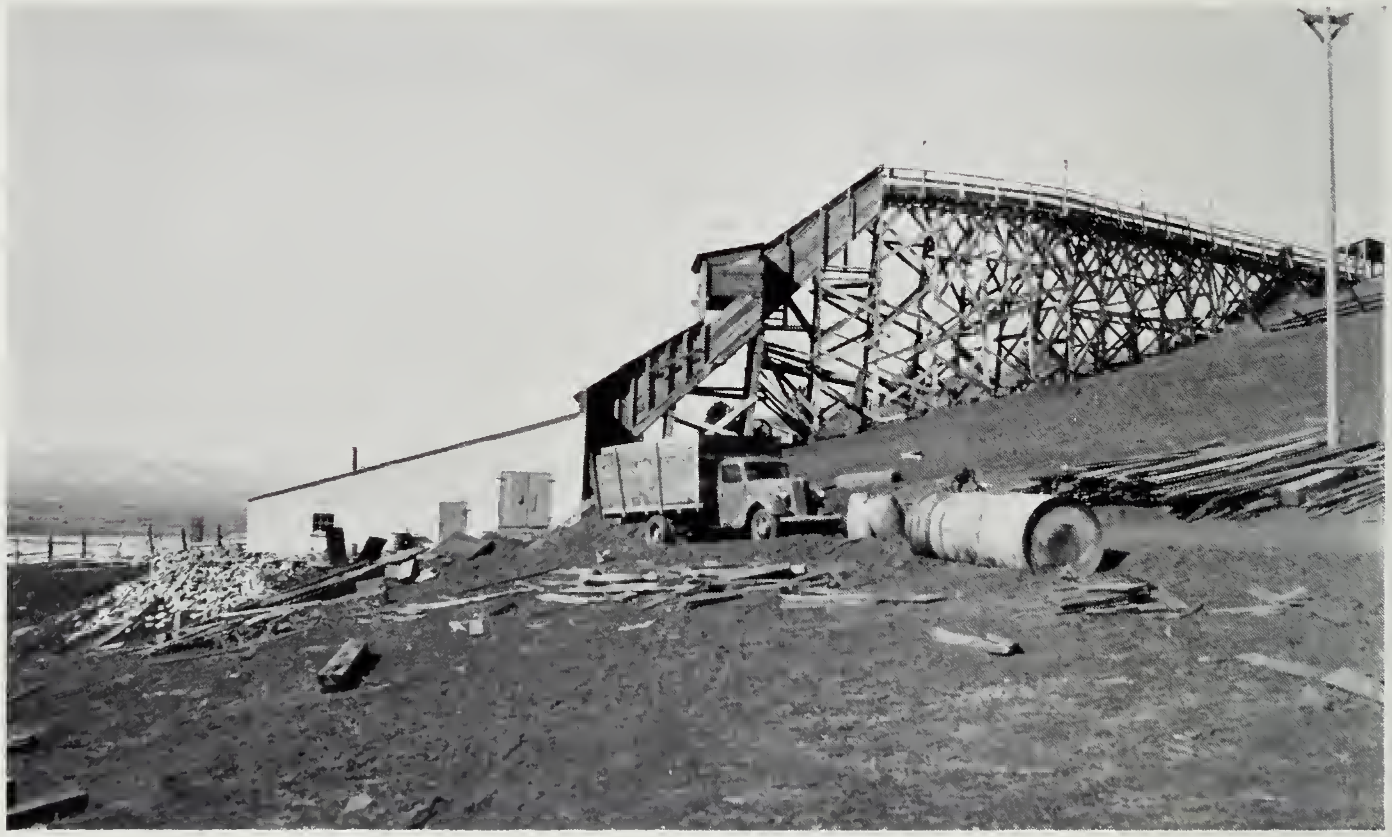

FIG. 2. Mill at Craig property

A mill with a rated capacity of 25 tons per day had been completed at the time of a visit on March 12, 1936, but it was not in operation. It contains a Huntington mill, plates for amalgamation, and tables for concentration. Power is furnished by a tractor engine. There is also a portable type compressor located at the mill.

Gold Shore Lode is in Sec. 6, T. 47 N., R. 16 E., and is a single claim held by George T. Cline, of Alturas. He has extended a tunnel started by Gold Shore Mining Co. an additional 100 ft. to give a total length of 300 ft. This work is in a rhyolite dike, 125 ft. wide and five to six miles long. It is being driven to locate one of the contacts of the dike, the strike of which is N. 15° W.

According to Cline, who is an assayer, and who has assayed many samples from this district, good float has been found in this vicinity over a tract four miles long and a mile and a half wide, giving assays from $750 to $1,200 per ton. He states that one 200-lb. piece assayed 51 ounces in gold and 43 ounces in silver to the ton.

Klondike Group in Sec. 1, 12, T. 47 N., R. 15 E., and Sec. 6, 7, T. 47 N., R. 16 E. It comprises 15 claims at an elevation of 7000 ft., held by W. B. Broaddus, of Fort Bidwell. The claims on the accompanying map (fig. 1) numbered 2, 3, 4, 5, 19, 30, 43, and 66 give an idea of the location in this group. The 90-ft. vertical shaft on

Klondike claim mentioned in State Mineralogist's Report XXV, has not been used recently. Broaddus is driving an adit level at a point some 600 ft. east of the shaft. This is a cross-cut designed to cut the original discovery vein, on which a 50-ft. shaft and some open cuts had been driven years ago. It is roughly 150 ft. lower in elevation than the collar of the shaft, and has been driven for a distance of 160 ft. Broaddus figures that he has 35 ft. yet to go. He states that the dumps from the shaft and the open cuts contain 1000 tons of $20 ore.

The vein material in the open cuts is largely breccia (probably rhyolitic) partly silicified, and containing seams of vein-quartz from a fraction of an inch to an inch wide, also much iron-oxide. The adit below is in a similar breccia, probably rhyolitic. In the face, the breccia is much silicified and is plentifully sprinkled with minute crystals of pyrite and chalcopyrite.

Machinery has been moved from the 90-ft. shaft to the portal of the new adit-level. A small mill has been built, to which both the compressor engine and the hoist-engine have been belted. Machinery includes the following: 36-hp. steam boiler (fired with wood); 12-hp. Byron Jackson vertical engine; 16-hp. steam hoist; 8-inch by 12-inch Blake crusher; 2 sets rolls, 9-inch diameter by 18 inches long; ball mill, 24 inches by 36 inches; 4 small flotation cells; 6-inch by 6-inch by 6-inch Rex compressor. The mill is said to have a 5-ton daily capacity when grinding to 40-mesh.

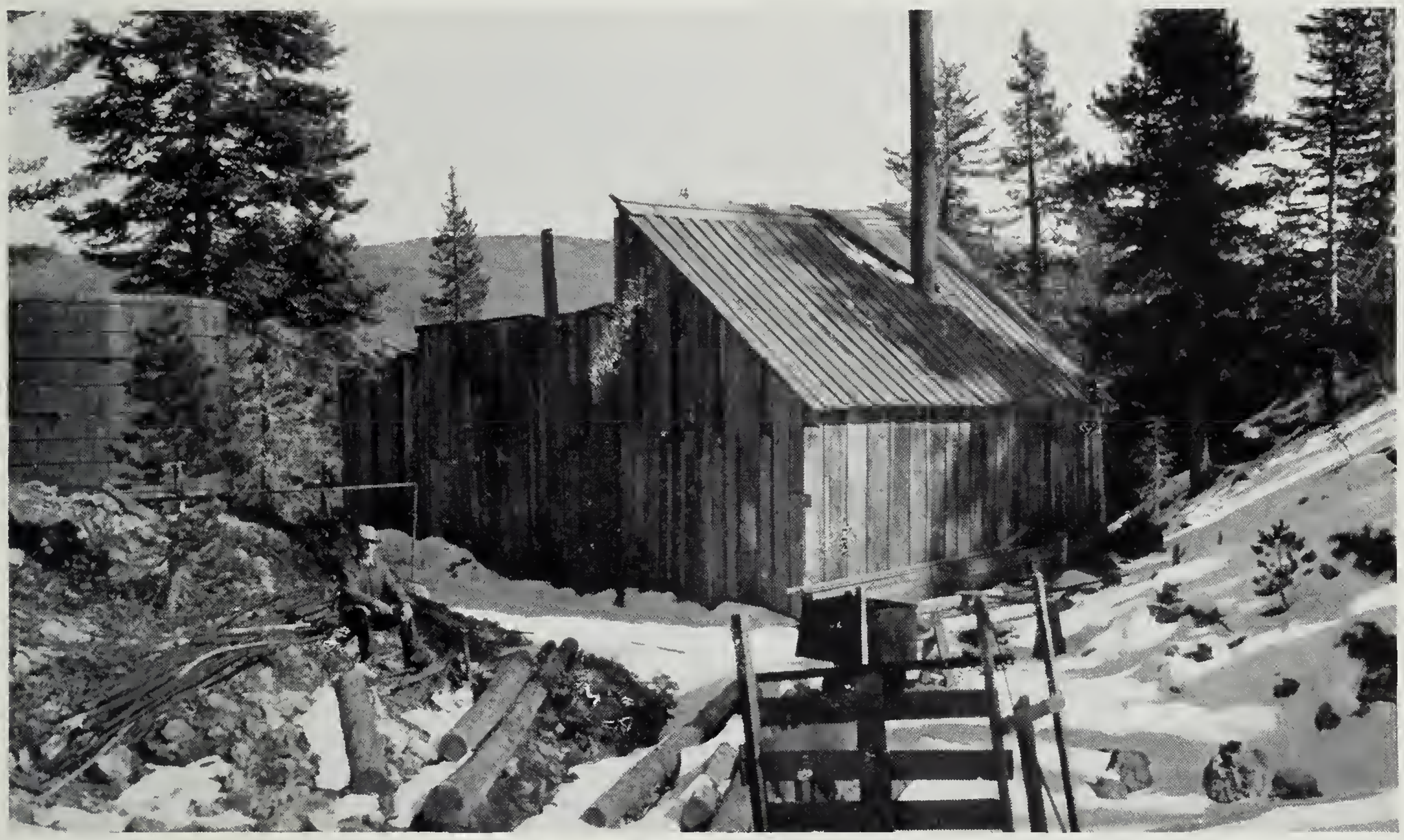

Fig. 3. Mill at Klondike group

Lost Cabin Mine (Hess) is in Sec. 28, 33, T. 41 N., R. 9 E., 28 miles west of Alturas, and is owned by A. K. Wylie, of Alturas. The old work at the property has been mentioned in the quoted material under the heading, "Geology of Winters District." The vertical shaft mentioned in the more recent reports (State Mineralogist's Report XXV, p. 14) has not been used recently.

A new mill has been built about 100 yards from the highway. It contains an 8 by 8-inch crusher to reduce the ore to one-inch size, followed by a 3-ft. by 4-ft. Hendy ball mill with a double screen on the discharge end. Inside screen is quarter-inch; outside screen is 30-mesh. Oversize from these screens is returned to the ball-mill by a bucket-elevator. Ore ground fine enough to pass through the 30-mesh screen flows to two Kraut cells, below which are two flotation cells operated by compressed air. The latter were designed and constructed by William S. Howell, operator of the mill. Power is derived from a 45-hp. Continental gasoline engine; and there is a 7½-inch by 7-inch compressor. Chemicals used include No. 301 and No. 208 American Cyanamid xanthates, cresylic acid, Aerofloat 25, Z6-Great Western pine oil. Copper sulphate is used as a cleaner. Lime is added at the head of the mill to make water alkaline to phenolphthalein. Capacity of the mill is one ton per hour. It has been idle during the past winter.

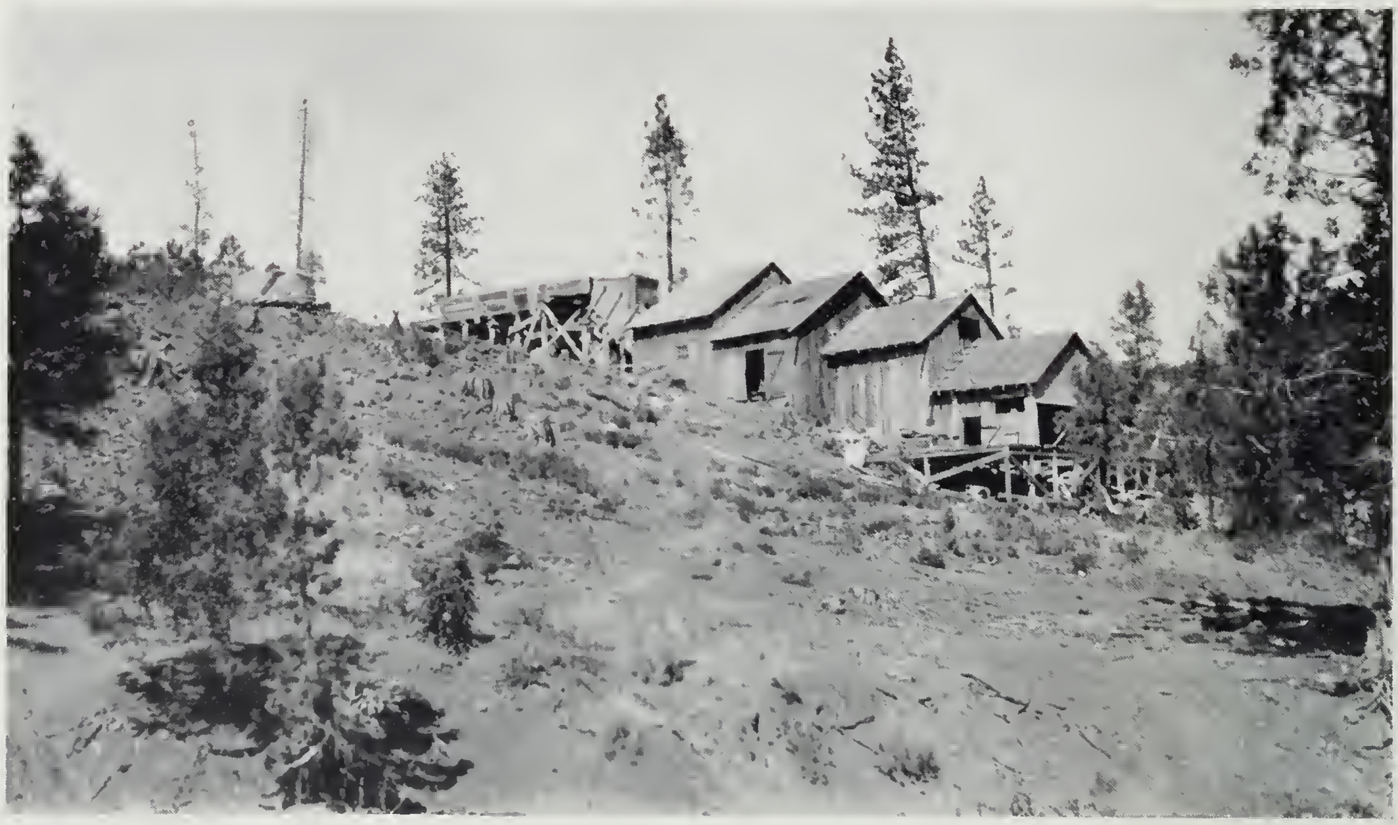

Fig. 4. Flotation mill

Ore for the last run of the mill came from a 90-ft. shaft near the incline-shaft mentioned in the older reports. Trouble was experienced on account of breaking into old, caved workings from the old shaft. Present work is being done on contract by three men, and consists of prospecting by drifting and crosscutting from a new 125-ft. shaft, which is 200 ft. west of the old incline. This work is in a fracture-zone in the andesite or basalt. Lateral work from the shaft amounts to about 100 feet. In this fracture-zone, occasional bunches and kidneys of gold ore with a gangue of quartz and calcite are found. Hoisting is done in buckets with a home-made power windlass driven by an old automobile engine.

Modoc Mine is in Sec. 36, T. 48 N., R 15 E., and is held by R. R. Baker, of Alturas, who has leased it to Wellman Smith and Floyd Smith of New Pine Creek, Oregon.

George T. Cline, of Alturas, did the sampling and assaying for the Modoc Mines Co. in 1913 and 1914. He has records of some 1000 samples taken and assayed at that time from workings from the 212-ft. shaft described in the above reference. The vein varied from 2 inches to 20 inches in width; and the gold content averaged from $15 to $20 per ton with gold at $20.67 per ounce.

Northern Star Mine, formerly known as the *North Star* or *Kohrnor,* is in Sec. 14, T. 47 N., R. 15 E. It comprises 160 acres at an elevation of 7500 feet.

In November, 1935, it was being operated for the Frank Morell Mining Company, 1419 Broadway, Oakland, by William W. Logan with a crew of 10 men. On five claims, application had recently been made for patent. A two-foot quartz vein strikes easterly and westerly, and dips 70° south. This vein outcrops well up on the side of the mountain.

At a point roughly 500 ft. distant and 400 ft. lower in elevation, a shaft is being sunk. It is planned to sink this to a depth of 205 ft. and then crosscut to the vein. Depth at time of visit was 160 ft. The shaft has two compartments, 4 by 3½ ft., and 4 by 4 ft., and is timbered with 6 by 8-inch timbers. Wall-rock of the vein is of very fine grain, probably andesitic. The shaft, at a depth of 160 ft., was in andesite of coarser grain. There is a parellel vein on the opposite side of the shaft that may be explored also.

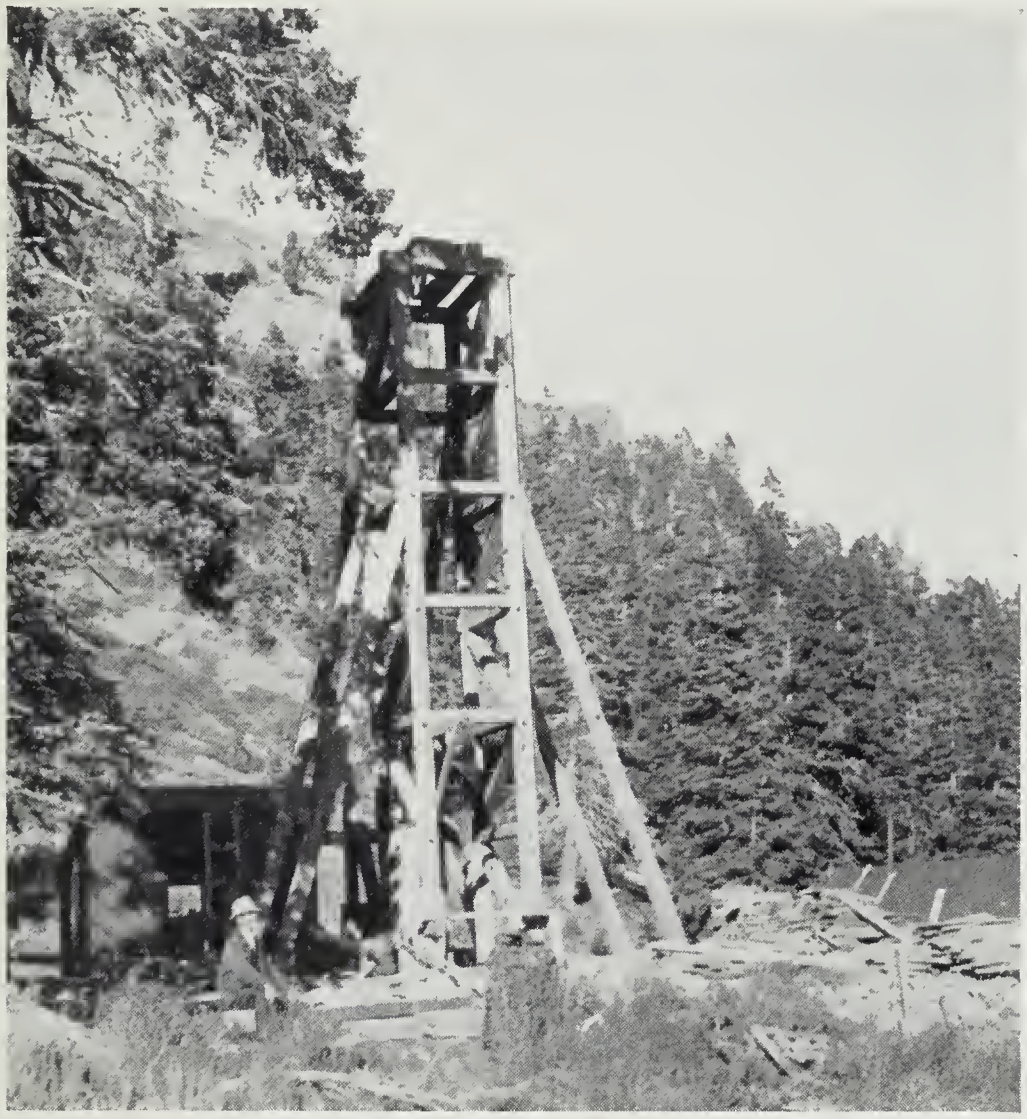

FIG. 5. Shaft on Northern Star

Equipment includes a gasoline hoist of 20-hp. and a 165 cu. ft. Rix compressor, portable type, driven by a gasoline engine. New buildings to accommodate the crew have been built.

Pleasant Mining Company is a corporation controlled by Fred Reynolds, Bert Snyder, A. J. Owsley, all of Lakeview, Oregon, and Charles Combs, Harry Plass and others. Willows Ranch is three miles west. Property is located just east of Alturas-Lakeview road at a point about a mile south of the Craig property. It was idle at time of visit, and was not examined. A few notes were obtained from W. H. Craig, who was in charge of operations in 1934, and early in 1935. There is reported to be some $50-ore exposed in an 18-inch vein in a 40-ft. shaft. A 10-ton ball mill with plates for amalgamation and tables for concentration was installed, but was later removed. Then a Gibson prospecting mill was installed, and it is still on the property.

MINERAL SPRINGS

Hot and warm springs are common in Modoc County; and many of them are used for irrigation and for domestic purposes. Waring [1] of the United States Geological Survey has described the following:

Allen Warm Springs, nine miles west of Alturas on the Alturas-Adin road. The flow is at the rate of 275 gallons per minute of slightly mineralized water of the alkaline type, with a temperature of 81° F.

Boyd Spring. This is located near the eastern side of Upper Lake in Surprise Valley. The temperature of the water is about 67° F.; and it is used for irrigation on the ranch of Wm. Jacobs of Lake City.

Kelly's Hot Spring. Owner, T. L. Chambers. Location, Sec. 29, T. 42 N., R. 10 E., on the state highway about 20 miles west of Alturas. The discharge is 325 gallons per minute, and the water is boiling. It has a slight odor of hydrogen sulphide; and in the ditch below the spring, where it has been cooled by exposure to the atmosphere, it forms a pink deposit of about the color of cinnabar. The owners say that the deposit has been tested, and has been found to contain mercury. Land irrigated with water from this spring produces 100 to 125 tons of hay per year. A concrete swimming tank has recently been built near the highway; and water is pumped from the spring to this.

A few notes on *other springs* that have not been named follow: About eight miles north of east from Kelly's Hot Springs, a stream named Hot Creek is formed by a number of hot springs that rise on the north side of the valley that borders Pit River. Near the head of Canyon Creek, a stream flowing into Pit River from the south at a point about midway between Alturas and Canby, are a number of warm springs. On the west side of Bidwell Creek, about a mile north of Fort Bidwell, are some hot springs, which are used by Joe Martin and M. M. Martin to feed a swimming pool. This is a concrete tank 50 by 30 feet. Hot springs are found also a few miles north of Lake City and on the east side of Surprise Valley.

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[1] Waring, G. A., U. S. Geol. Survey, Water Supply Paper 338, Springs of California.

STONE

The volcanic tuffs of Modoc County afford a supply of stone, of many different colors and shades, that is easily cut to size and shape for building purposes. The high school and the office building of the Nevada, California and Oregon Railroad at Alturas, and several other buildings have been constructed of cut stone of this kind. Following are the names of the owners and the locations of the quarries: L. H. Sisson, P. S. Dorris and W. J. Dorris, of Alturas, have a quarry in Sec. 22, T. 42 N., R. 12 E. Ivy S. Raker, of Susanville, has a quarry in Secs. 22, 27 and 28, T. 42 N., R. 12 E. B. L. Kelly, af Alturas, has a quarry in Sec. 7, T. 42 N., R. 12 E. W. E. Minard, of Alturas, has a quarry in Secs. 14 and 23, T. 42 N., R. 12 E., from which the mottled stone used in the construction of the N., C. & O. office building was taken.

SACRAMENTO FIELD DISTRICT

C. A. Logan, Mining Engineer

On account of unfinished field work, there is no report from the Sacramento Field District in this issue.

SAN FRANCISCO FIELD DISTRICT

C. McK. Laizure, Mining Engineer

Reports covering the mines and mineral resources of all of the counties in the San Francisco field district are now available, and field work at present is confined to investigations for special reports upon various economic minerals.

LOS ANGELES FIELD DISTRICT

W. B. Tucker and R. J. Sampson, Mining Engineers

On account of unfinished field work, there is no report from the Los Angeles Field District in this issue.

GEOLOGIC BRANCH

CURRENT NOTES

By Olaf P. Jenkins, Chief Geologist

One of the most prominent geological features of California, significant to everyday life, to engineering and mining enterprises, and to the oil industry, is also one of the most neglected problems, i.e.—landslides. One phase of the subject, The Mechanics of Landslides, has been recently studied in detail by William M. Cogen, whose Ph.D. thesis on the subject is now deposited in the Geology Department of the California Institute of Technology. In treatment of the subject several specific landslides were investigated: the Huntington, Potrero Canyon, Bel Air, and Temescal landslides of Southern California, and the Parker Avenue and Turk Street landslides of San Francisco. These were all active earth movements at the time they were studied. In order to make public some of the results of his investigations a group of these interesting samples is presented in the following article, "Mechanics of the Lone Mountain Landslides of San Francisco."

The study and distribution of landslides in respect to the character of the underlying geological formations to the position of recent faults and to other natural phenomena still remain problems open to investigation. The relationship of landslides to road-building and to the placement of foundations for structures, and bridge anchorages are problems which have been sadly neglected.

We now know of ancient landslides in California so large in extent that they cover areas to be measured in square miles. We know of several lakes, exemplified by Clear Lake, north of San Francisco, which have been formed by landslides stopping the drainage outlets of valleys. In some cases the ancient surface earth movements may be attributed to earthquakes, of which we now have no other record. Prominent geologists have often been badly confused in their areal mapping by rock material moved from considerable distances, now covering and completely concealing the outcrop of the existing formations.

It is our hope that the following article will stimulate further investigations where earth movements now are taking place, and also where movements may operate in the future. To understand these more fully the ancient slides should also be investigated. Engineers should become more conscious of the problems involved and geologists should assist in the study.

MECHANICS OF THE LONE MOUNTAIN LANDSLIDES, SAN FRANCISCO, CALIFORNIA*

By William M. Cogen

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ABSTRACT

This study was initiated for the purpose of determining the mechanics and causes of three landslides that had occurred on Lone Mountain. A careful survey was made of the geology at the slide localities. By means of graphical methods based on the principles of soil mechanics, the frictional resistance to sliding, which the ground exerted when motion impended, was determined. The inherent frictional properties of the ground were evaluated by laboratory experiments on samples of material obtained from the slide localities. Discordance between the graphical and the experimental values for the friction coefficients points to the presence of an agent which nullified, in part, the action of friction.

The natural stability of the hillside on which the Parker Avenue slide occurred was reduced through a series of civic improvements which, in combination with the unfavorable geologic structure and the presence of water, ultimately caused the landslide.

The two smaller slides along Turk Street may be attributed to the hydro-dynamic action of water in the highly porous and unconsolidated sandy ground, with the consequent reduction of friction betweeen the sand grains, and resultant liquefaction of the hillside mass.

PARKER AVENUE LANDSLIDE

Introduction.

On Thursday morning, December 26, 1935, a landslide occurred on the west slope of Lone Mountain in San Francisco. Much attention was attracted to this slide because of the attendant damage to streets and power lines, and because the San Francisco College for Women, a new and costly structure, was left standing in an apparently unsafe position close to the edge of a steep 30-foot escarpment. (Fig. 1.)

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* Excerpt from thesis, "Mechanics of Landslides," submitted to the Balch Graduate School of the Geologic Sciences, California Institute of Technology, Pasadena, California.

The following newspaper account describes the movements of the earth mass prior to the major slip on Thursday:

''The unstable earth gave warning early Tuesday afternoon. A new 6-in. main to serve the subdivision gave way and spurted water. Workmen found an earth movement had shifted it about 8 inches, according to E. G. Cahill, manager of utilities. When the water was turned off at 3 p.m. Parker Avenue was exhibiting a bulge.

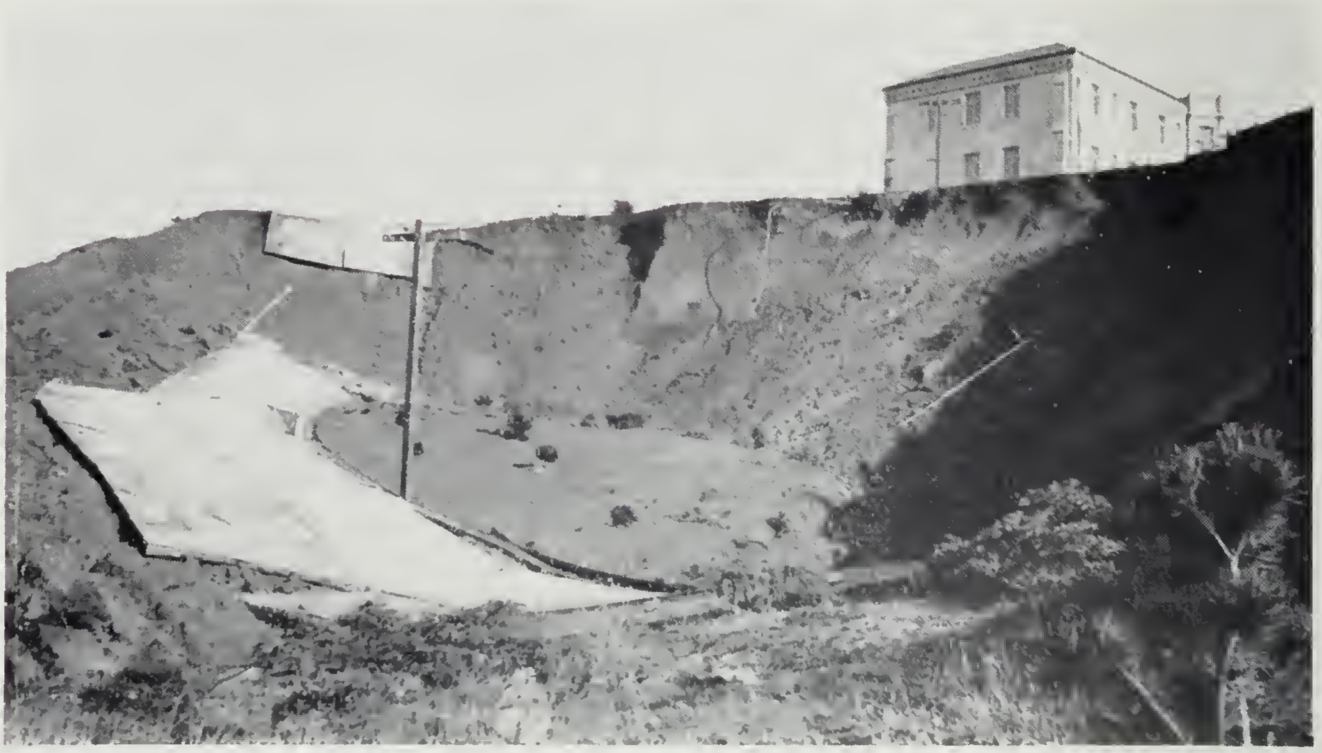

FIG. 1. Escarpment formed by Parker Avenue landslide. San Francisco School for Women in background

''There was some movement later that day and some cracks showed in the hillside Wednesday. At 12.10 a.m. yesterday (Thursday) there apparently was a prelude of sufficient jarring force to stop the clock in the Gothic tower of the college library, although no impact was noted by W. M. Putney, special police guard on the campus.''[1]

History of Civic Improvements.

A review of the history of public and private improvements on and adjacent to Lone Mountain, and a description of the geology at the landslide locality will be useful for the recognition of the factors contributory to the slide.

Briefly, the history of improvements is as follows: In August of 1919 the pavement on Parker Avenue was completed. This improvement involved the removal of a prism of earth along the base of the west side of Lone Mountain. In January of 1933 construction of the college on the top of the hill was completed. Two years prior to this construction the hill-top was graded and the excess rock was thrown on the slopes. About October 15, 1935, grading for the new subdivision at the foot of Lone Mountain immediately to the west of Parker Avenue was completed. The ground adjacent to the street was reduced to the same level as the edge of the pavement and from there the slope was gently downward toward the west and north. The landslide occurred on December 26, 1935, approximately 2½ months after the ground for the subdivision had been graded.

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[1] San Francisco Chronicle, December 27, 1935.

Geology.

A knowledge of the geology of Lone Mountain is essential to a proper understanding of the landslide. Unfortunately no borings of the slide mass had been made up to March 27, 1936, the date on which the writer concluded his field investigations. The geology to be described is based, therefore, on surface observations and all subsurface sketches and descriptions are inferential.

The core of the hill is of greenstone, a much-altered basic rock composed in large proportion of serpentine. It is exposed in the street cuts nearby and was encountered in the excavations for the structure situated on the crown of the hill. It ix exposed in many parts of San Francisco, and forms an important lithologic member of the Franciscan formation.

Overlying and depositional upon the greenstone is a sandstone stratum moderately indurated and of variable thickness. It is massive in character and grades upward from coarse angular particles of 1- and 2-in. dimensions to medium-grained sand. The basal contact of this stratum is very distinct and shows the irregularity of the old greenstone surface. The sandstone is well exposed along Parker and St. Rose Avenues at the base of Lone Mountain.

The sandstone is overlain by wind-blown sand which is loosely compacted and appears to owe its coherence chiefly to moisture. It forms the major rock covering of the hill slopes, and because of its loose character masks the contact with the underlying formation. On top of the dune sand, and only present along the edges of the flat hilltop, is a comparatively thin layer of fragmental greenstone which was dumped there during grading operations prior to construction of the college.

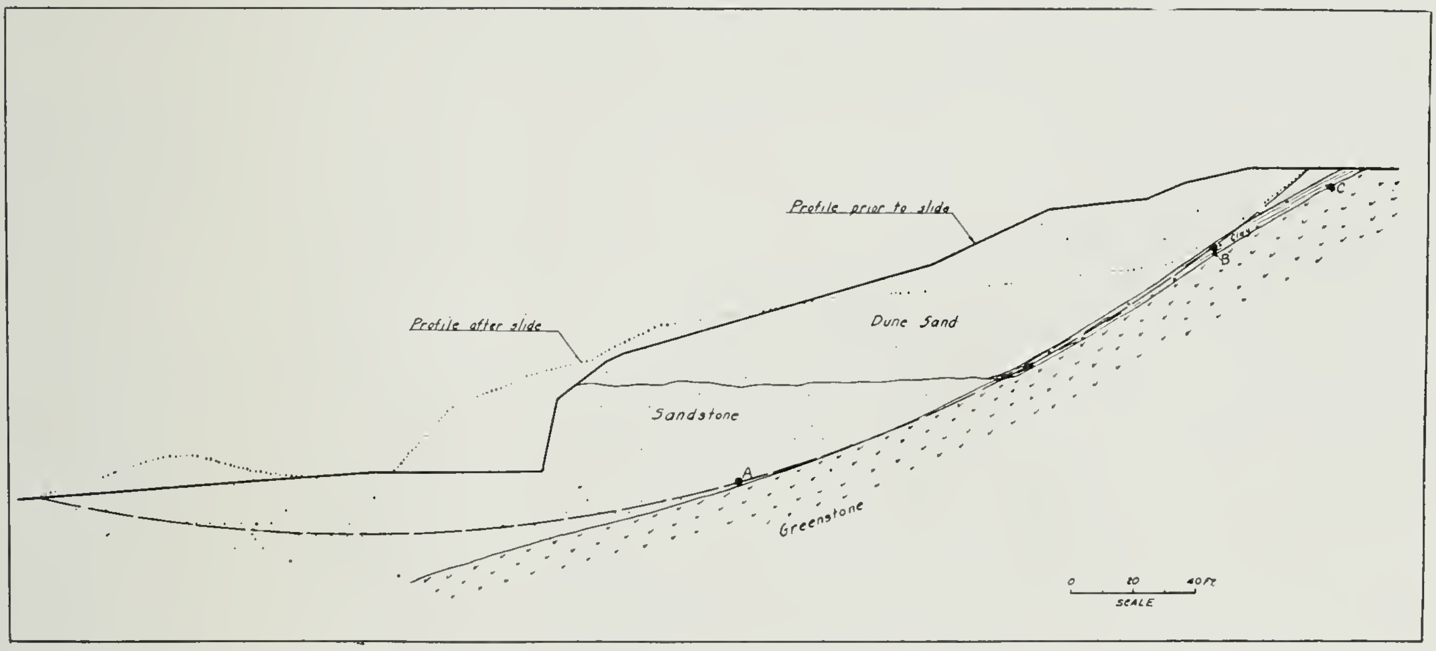

FIG. 2. Geologic section through hillside at station 12+00 along Parker Avenue, Lone Mountain, San Francisco

The stratigraphic succession of rocks forming Lone Mountain at the slide locality is comparatively simple. Serpentinized greenstone occurs at the base, followed successively upward by massive sandstone, dune sand, and recently excavated fragmental material. The subsurface structural relations are more complex because of the irregular surface of the greenstone, but they may be inferred from exposures in the street cuts and from evidence exposed on the steep face of the escarpment made by the landslide at its upper edge. This escarpment is about 35 feet high and is crescent-shaped. Almost the entire exposure is of dune material. However, in the central section of the crescent, about 15 feet below the crest of the slope and underlying the wind-blown sand, there is a clay outcrop, which, towards the ends of the crescent, passes into dune sand. This clay contains angular fragments of greenstone and appears to have been an early soil cover, formed as a weathering product on the slopes of the greenstone before it was covered by dune sand. The thickness of the clay is not known, but is probably 10 feet or less. The writer believes that the greenstone lies within 10 feet of the clay exposure, although nowhere was it exposed on the face of the escarpment. The only exposure showing greenstone in actual contact with the slide-mass is in the Parker Avenue cut where the trace of the northern edge of the landslide passes along the contact between greenstone and sandstone. From this geologic evidence subsurface structural relations have been inferred. (Fig. 2.)

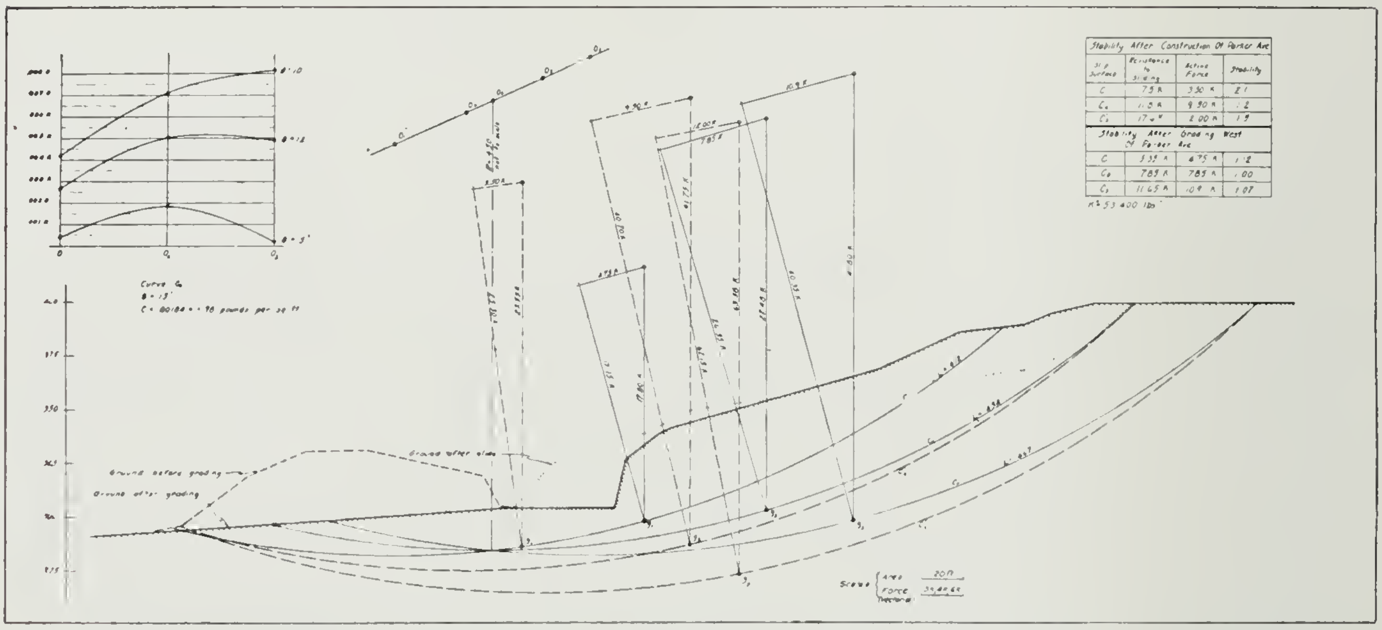

FIG. 3. Graphic determination of requisite resistance to sliding for cross-section through landslide at station 12+00 along Parker Avenue. Note: Broken lines represent ground profile prior to grading; solid lines, after grading.

It is very probable that the greenstone surface beneath the hill slope of Lone Mountain acted as a control on the shape and position of the slip-surface of the landslide. It should be understood, however, that geologic structure is not alone the cause of landslides. Their immediate cause is an unbalanced component of the force of gravity.

Effects of Civic Improvements on Stability of the Hillside.

The writer has made a study of the Lone Mountain landslide with the object of quantitatively evaluating the effects produced by the removal of rock material consequent upon the various public and private improvements on and adjacent to Lone Mountain.

The problem resolved itself into two parts: first, to determine the values of the coefficients of cohesion and friction that existed along the slip-surface when the landslide was imminent; second, using these coefficients, to determine the stability of the hill slope under the various conditions created by the civic improvements.[2]

Table 1, Appendix B, shows the values for the coefficients of cohesion that are required to maintain equilibrium along each hypothetical slip-surface when various values are assumed for the angle of friction. The data of Table 1 have been plotted to give a series of curves. (Fig. 3.) The curve whose maximum falls on abscissa O_2 shows a friction angle of 15° and a cohesion of 98 lbs. per sq. ft. for slip curve C_2 along which the slide is presumed to have occurred.

Knowing the values of the coefficients of friction and cohesion, it is possible to determine the stability of hillsides with various shapes and angles of slope. Stability is defined as the ratio of the force which resists movement to the force which actuates movement along some slip-surface. A value of 1 indicates the lower limit of stability, e.g., motion is impending. Slopes with stability ratios greater than 1 are stable; those with ratios less than 1 are unstable.

Figure 4 shows a section through the original hillside prior to the construction of Parker Avenue. The table on this plate shows that the hillside possessed a stability of 1.5 against sliding. Construction of Parker Avenue, which entailed the removal of a sizeable earth prism from the base of the hill, caused the stability against sliding on a surface passing beneath the pavement to drop to 1.2. (Fig. 3.) At the same time it created an unstable zone for ground lying above the toe of the slope in the Parker Avenue cut. (Fig. 5.) The final grading of the ground adjacent to and west of Parker Avenue reduced the stability of the hillside for a slip-surface passing beneath Parker Avenue to a value of 1, the lower limit of stability. (Fig. 3.) Failure occurred on December 26, 1935.

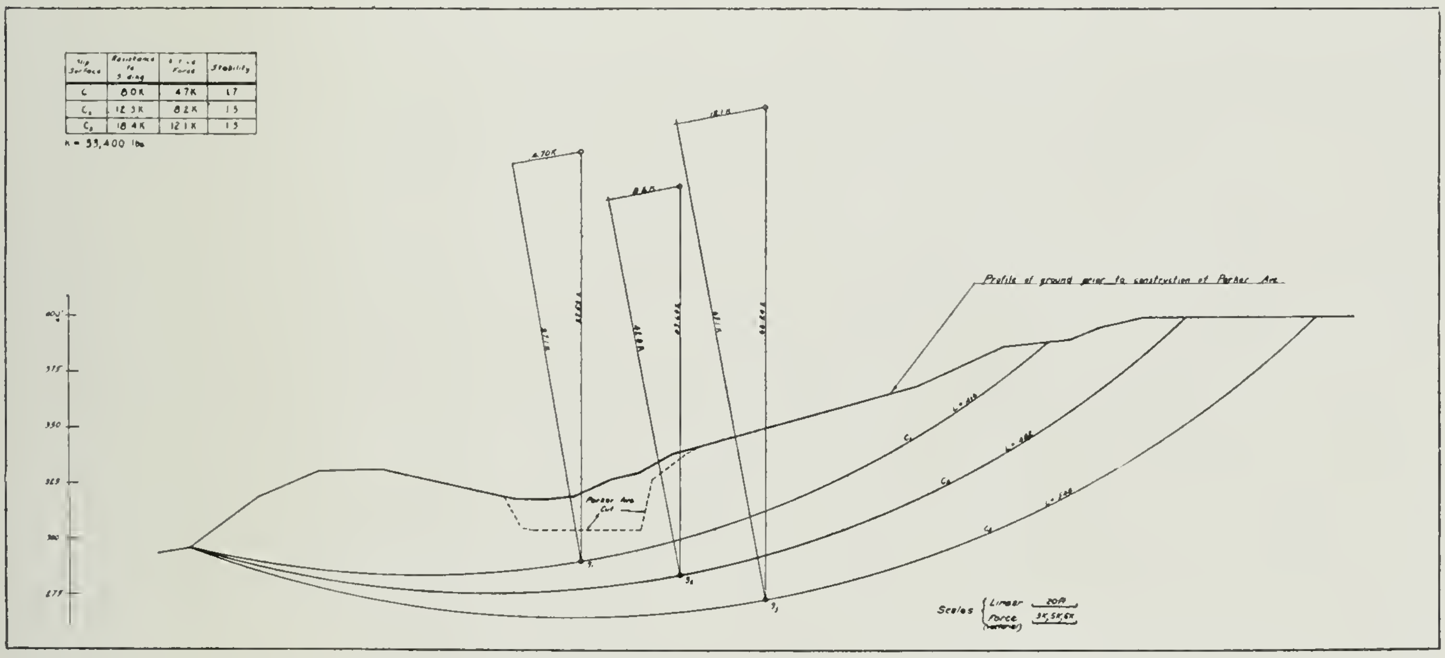

FIG. 4. Graphic determination of requisite resistance to sliding for cross-section through hillside at station 12+00 along Parker Avenue

The construction of Parker Avenue created an unstable zone in the ground above the toe of the east slope of the cut. (Fig. 5.)

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[2] See Appendix A for a description of the graphical method that was used to determine the values of the coefficients of friction and cohesion.

Using the values for the coefficients based on the ground profile subsequent to the grading west of Parker Avenue and prior to the landslide, the calculated stability against sliding in this zone is less than 1. Therefore, sliding should have occurred. The fact that slides did not occur is evidence to the effect that the coefficients for the ground in this zone were greater than those which acted along the slip-surface of the Parker Avenue slide.

Samples of the dune sand and of the clay taken from the slip-surface exposed at the upper edge of the landslide were tested in the laboratory. (See Appendix B.) The experimental values for the angle of internal friction are 21° for the clay and 41° for the sand. (Figs. 6, 7.) The graphically determined value for the angle of friction that acted when motion impended is 15°. Apparently the full frictional properties of the ground as measured by experiment were not exerted at the instant of sliding.

It is believed that the slip occurred partly along the buried surface of the greenstone, and that the full force of friction was prevented from acting because of a film of water along the buried greenstone surface. (Fig. 2.) This film supported a portion of the superincumbent load and consequently reduced the pressure between it and the underlying rock along the contact. The effect of the decreased pressure was to reduce the frictional resistance but leave undiminished the tangential force acting to produce sliding along the slip-surface.

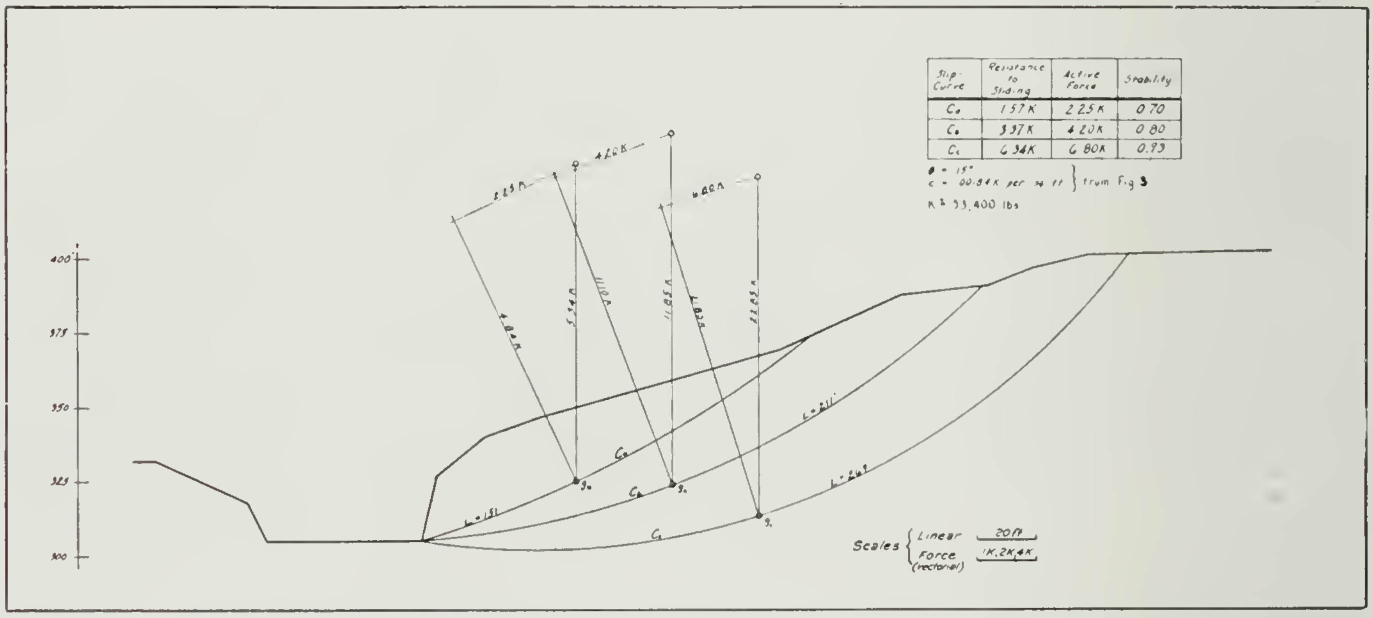
Slip-Curve | Resistance to Sliding | Active Force | Stability
Cₐ | 157K | 225K | 0.70
C_b | 337K | 420K | 0.80
C_c | 634K | 680K | 0.93
φ = 15°
c = 00.84K per sq ft } from Fig 3
K = 33,400 lbs
400'
375
350
325
300
225K
420K
680K
4.84K
5.34K
11.01K
11.05K
1.83K
12.05K
L=151'
L=211'
L=249'
Cₐ
C_b
C_c
gₐ
g_b
g_c
Scales { Linear 20ft
Force (vectorial) 1K,2K,4K

FIG. 5. Graphic determination of requisite resistance to sliding for cross-section through hillside at station 12+00 along Parker Avenue

Much of the water used to sprinkle and irrigate the land surrounding the college on top of the hill sank into the ground, and probably percolated downward along the buried greenstone surface. Although the sandstone overlying the greenstone is not an impervious rock, the passage of water through it was probably impeded sufficiently to create a head of water along the contact of the sandstone and greenstone.

This concept of hydraulic pressure acting along the greenstone is supported by the fact that the landslide did not occur along a surface passing through the toe of the Parker Avenue cut. As previously pointed out, a danger zone existed along slip-surfaces passing through the east toe of the Parker Avenue cut. The requisite angle of friction

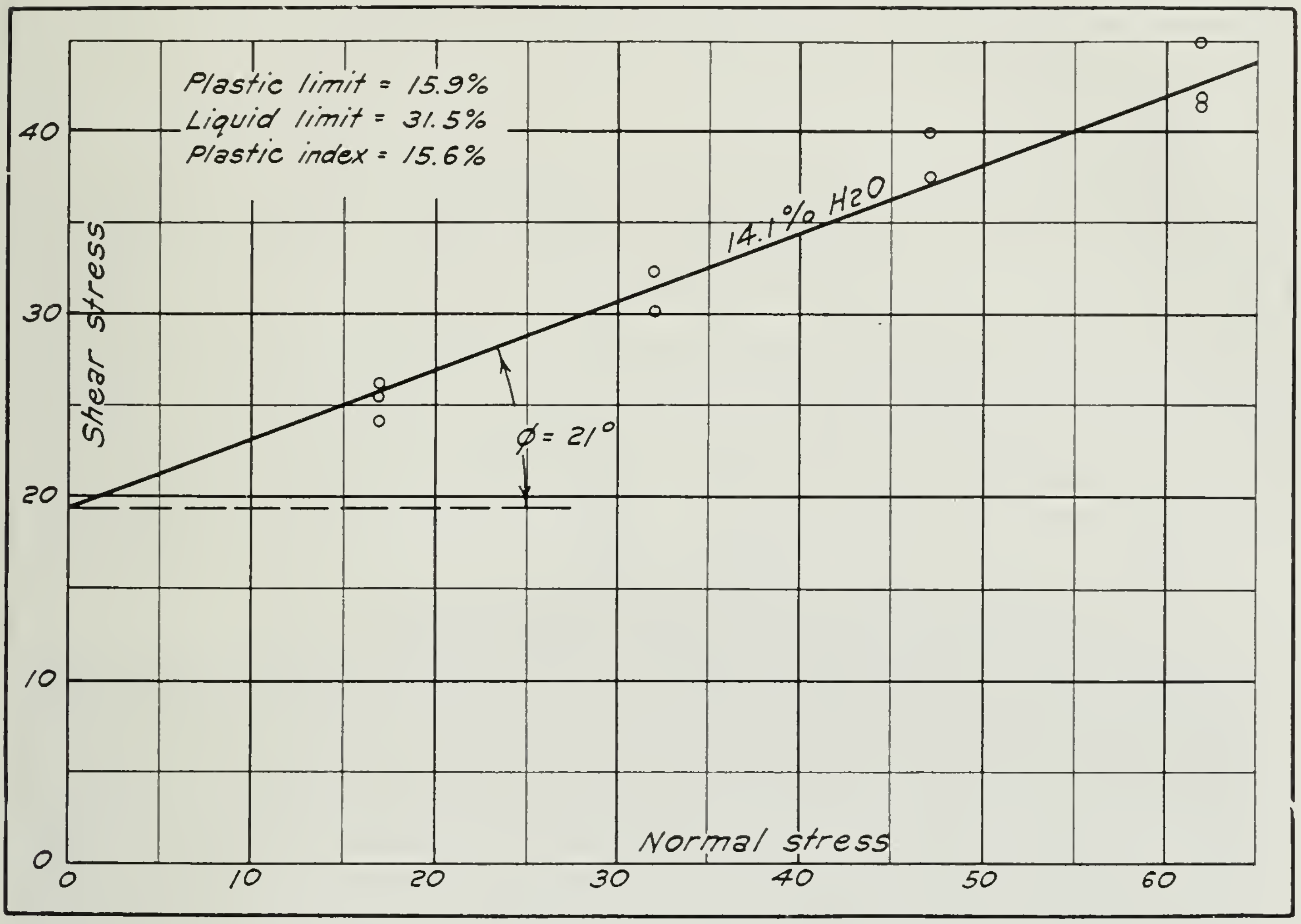

FIG. 6. Pressure-shear diagram, molded sample, clay and gravel, Parker Avenue slide

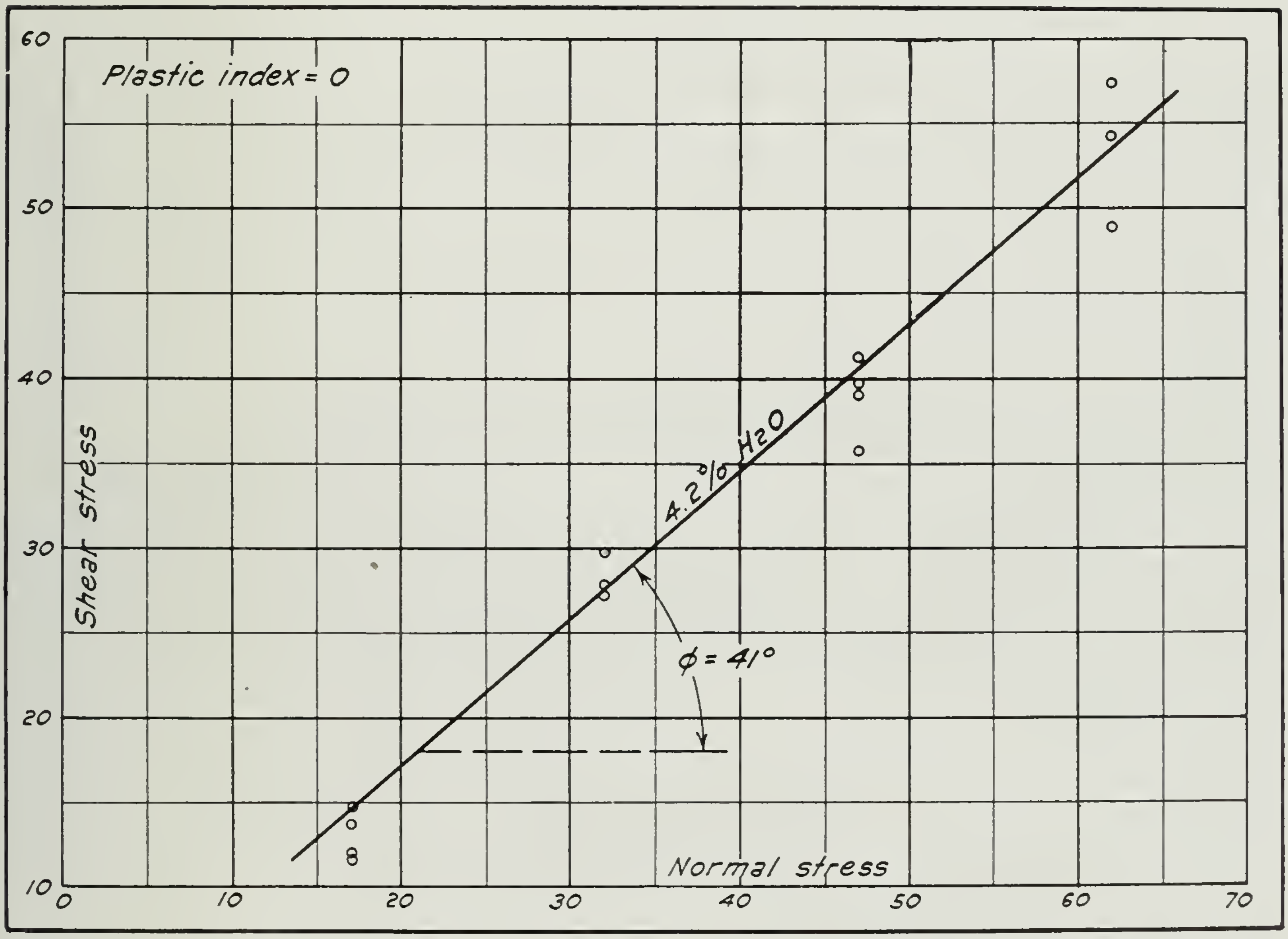

FIG. 7. Pressure-shear diagram, molded sample, dune sand, Parker Avenue slide

for stability was greater than that for the slip-surface along which the slide actually occurred. No slide occurred through the toe because the static frictional force inherent in the material was not reduced through hydraulic action.

Weakness of the hillside can not be attributed to natural precipitation. Report from the U. S. Weather Bureau show a total precipitation of 1.24 inches for the month of November and of 0.89 inch for the first twelve days of December, followed by an interval of thirteen

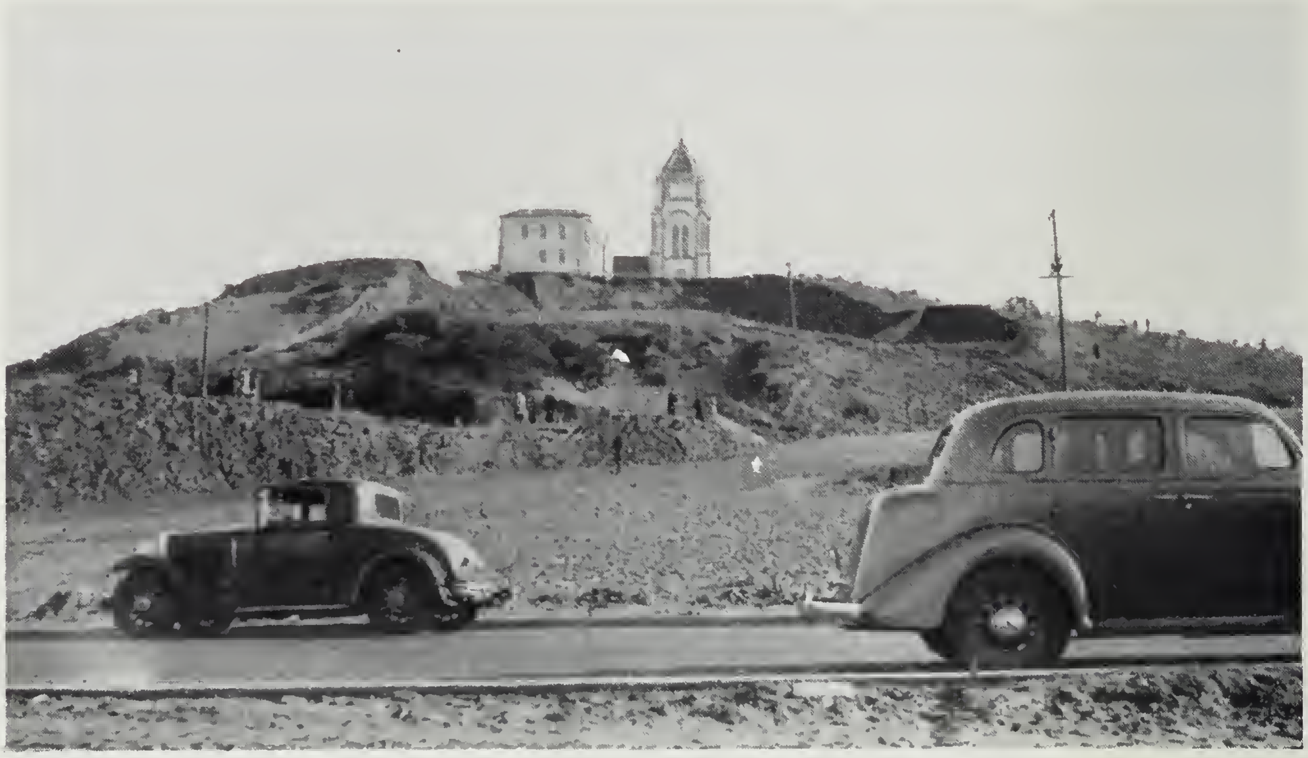

FIG. 8. View looking eastward of Parker Avenue landslide, Lone Mountain

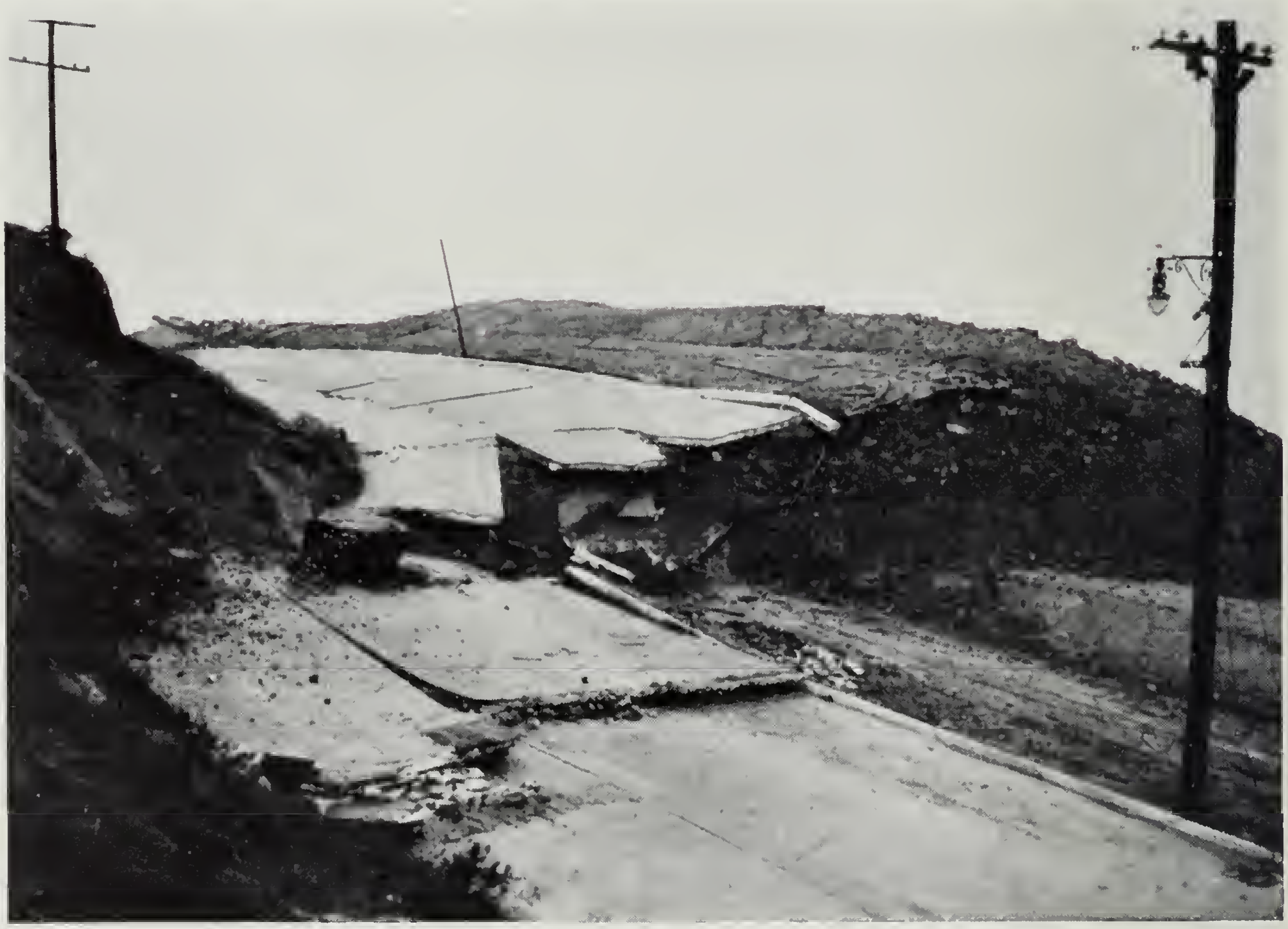

FIG. 9. Offset in pavement of Parker Avenue along northern edge of landslide

days prior to the time of the slide during which no precipitation occurred. This amount of rainfall is no greater than the average for many years in the past, and can not logically be considered as the cause of the landslide.

The position of the mound at the toe of the landslide suggests that the ultimate cause of the slide was the removal of the formerly existing knoll and the grading of the ground at the base of Lone Mountain. It should be observed that the undisturbed ground at the base of the hill slopes down toward the north. (Fig. 8.) Moreover, the mound was not thrust up along the entire front of the slide, but only along the northern half where the graded ground was lower. Thus it appears that as the ground surface sloped downward toward the north it passed below the elevation which it should have had in order to maintain equilibrium, and consequently, when the hill mass slid, a mound was thrust up where the ground lay below this elevation.

Summary of Contributory Causes of Landslide.

A chronologic summary of the factors contributing to cause the landslide is as follows:

1. The construction of Parker Avenue in 1919 and the consequent removal of a sizable earth prism from the base of Lone Mountain reduced the stability of the hillside.
2. The continuous watering of the grounds atop the hill following construction of the college in 1933, and the probable percolation of the water along the buried greenstone surface served to create a hydraulic lift resulting in the reduction of frictional resistance to sliding along this surface.
3. The grading to the west of Parker Avenue, completed in October, 1935, reduced the stability of the hillside to the limit of equilibrium.

TURK STREET LANDSLIDES—SAN FRANCISCO

Locality and Geology.

In addition to the large landslide along Parker Avenue several other slides have occurred on Lone Mountain. Two such slides studied by the writer occurred on the south side of Lone Mountain along Turk Street near its intersection with Parker Avenue. These have been designated in this report as landslides A and B. A is the westernmost of the two.

The ground in which these slides occurred is a dune sand, loosely packed and with practically no coherence save that caused by moisture.

No greenstone was exposed in the immediate vicinity of these slides, and the writer does not believe that these slips occurred along a buried greenstone surface.

Evaluation of Acting Forces.

The graphical calculations (Figs. 10 and 11) give as the limiting values for equilibrium possessed by the ground of landslide A, 18° for the angle of internal friction and 50 lbs. per sq. ft. for the coefficient of cohesion; for slide B, 12° and 220 lbs. per sq. ft.

The experimental value for the angle of internal friction of the dune sand is 41°. (Fig. 7.) Even under the assumption that the dune sand possessed no cohesion, a friction angle of 41° should have been more than sufficient to give the slope a high degree of stability; that is, slopes up to a maximum steepness of 41° should have been stable. Yet two landslides occurred on slopes of approximately 25°.

Causes of the Landslides.

It is obvious that these landslides occurred under conditions that nullified, at least in part, the frictional resistance inherent in the ground. The writer has not been able to secure information from an eye witness concerning the condition of the ground at the time of sliding. It is possible, however, to infer the conditions that must have existed. The loose texture and lithology of the material involved in these landslides are admirably suited for the development of a hydrodynamic stress, and are therefore strongly suggestive of the phenomena that caused the slide.

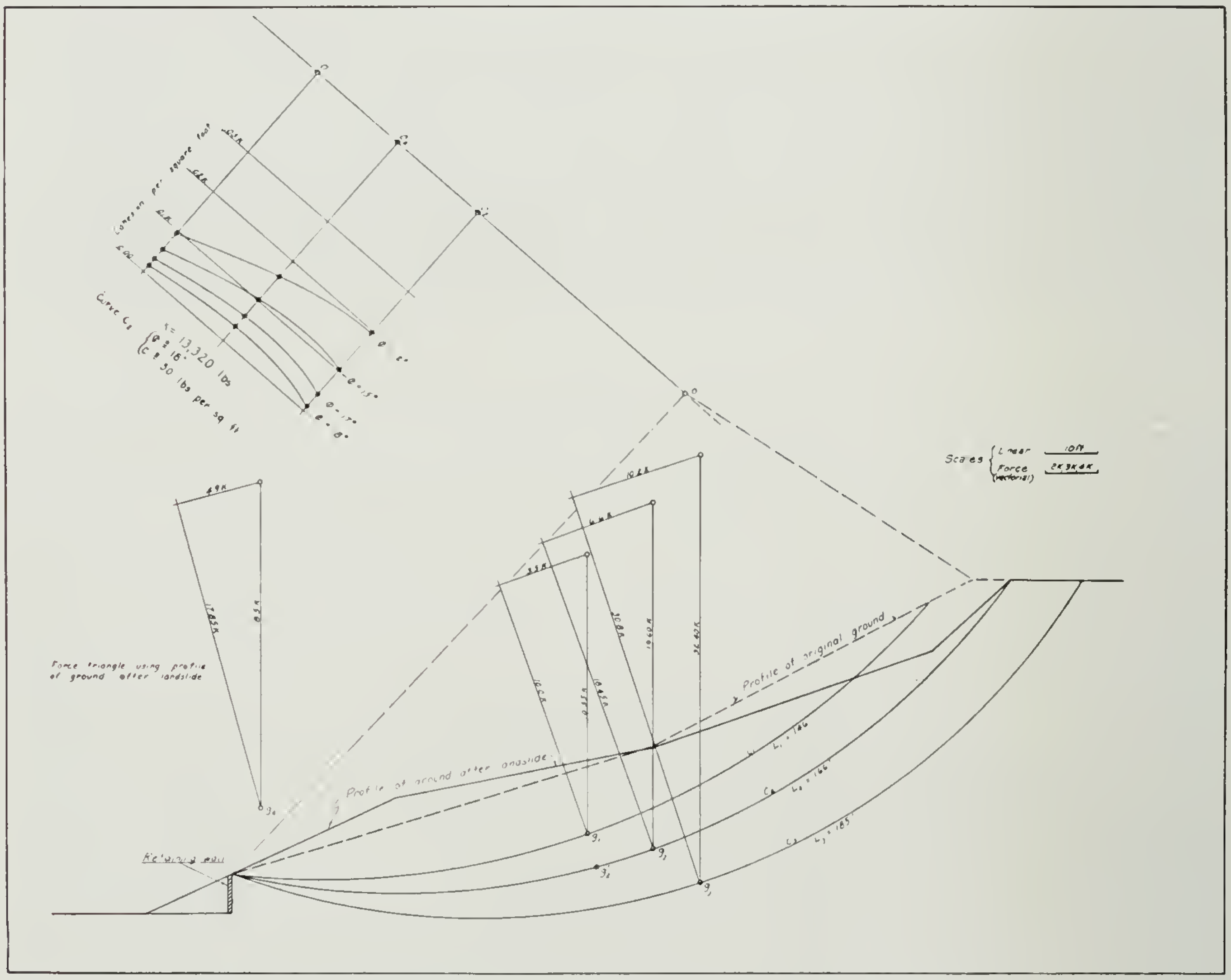
Cohesion per square foot
Curve C₃
P = 13,320 lbs
φ = 16°
C = 30 lbs per sq ft
φ = 15°
φ = 17°
Scales
Linear 10ft
Force (vectorial)
4.9K
17.85K
Force triangle using profile of ground after landslide
Profile of original ground
Profile of ground after landslide
Retaining wall
10.8K
20.8K
10.6K
24.42K
L₁ = 186'
L₂ = 166'
L₃ = 185'
C₁
C₂
C₃
g₁
g₂
g₃

FIG. 10. Graphic determination of coefficients of cohesion and friction for cross-section through landslide "A" along Turk Street, San Francisco

The following conditions leading to the landslides are inferred: The loosely packed dune sand became soaked with water as a consequence of rains. Street cars and motor trucks passing along Turk Street created vibrations that were transmitted to the adjacent hillside. Such vibrations occurred at some instant when the dune sand was saturated with water, and were strong enough to produce in the sand

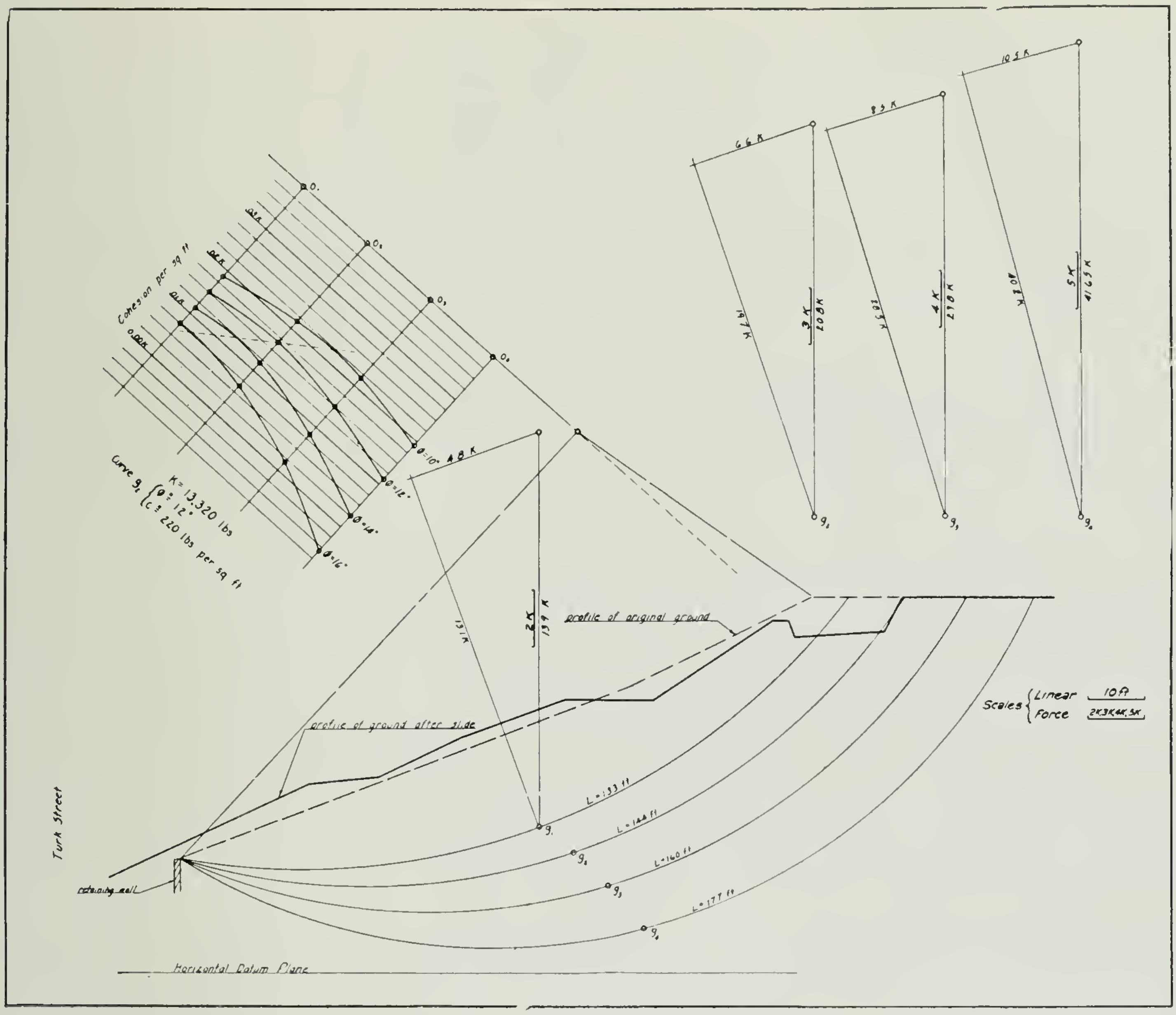
Cohesion per sq ft
O₁
O₂
O₃
O₄
Ø=10°
Ø=12°
Ø=14°
Ø=16°
Curve g₁ { K = 13,320 lbs
Ø = 12°
C = 220 lbs per sq ft
4.8 K
131 K
2K
139 K
6.6 K
19.7 K
3K
208 K
8.5 K
28.3 K
4K
279 K
10.5 K
30.8 K
5K
416.5 K
g₁
g₂
g₃
g₄
profile of original ground
profile of ground after slide
Turk Street
retaining wall
L = 133 ft
L = 144 ft
L = 160 ft
L = 177 ft
Scales { Linear 10 ft
Force 2K 3K 4K 5K
Horizontal Datum Plane

FIG. 11. Graphic determination of coefficients of cohesion and friction for cross-section through landslide "B" along Turk Street

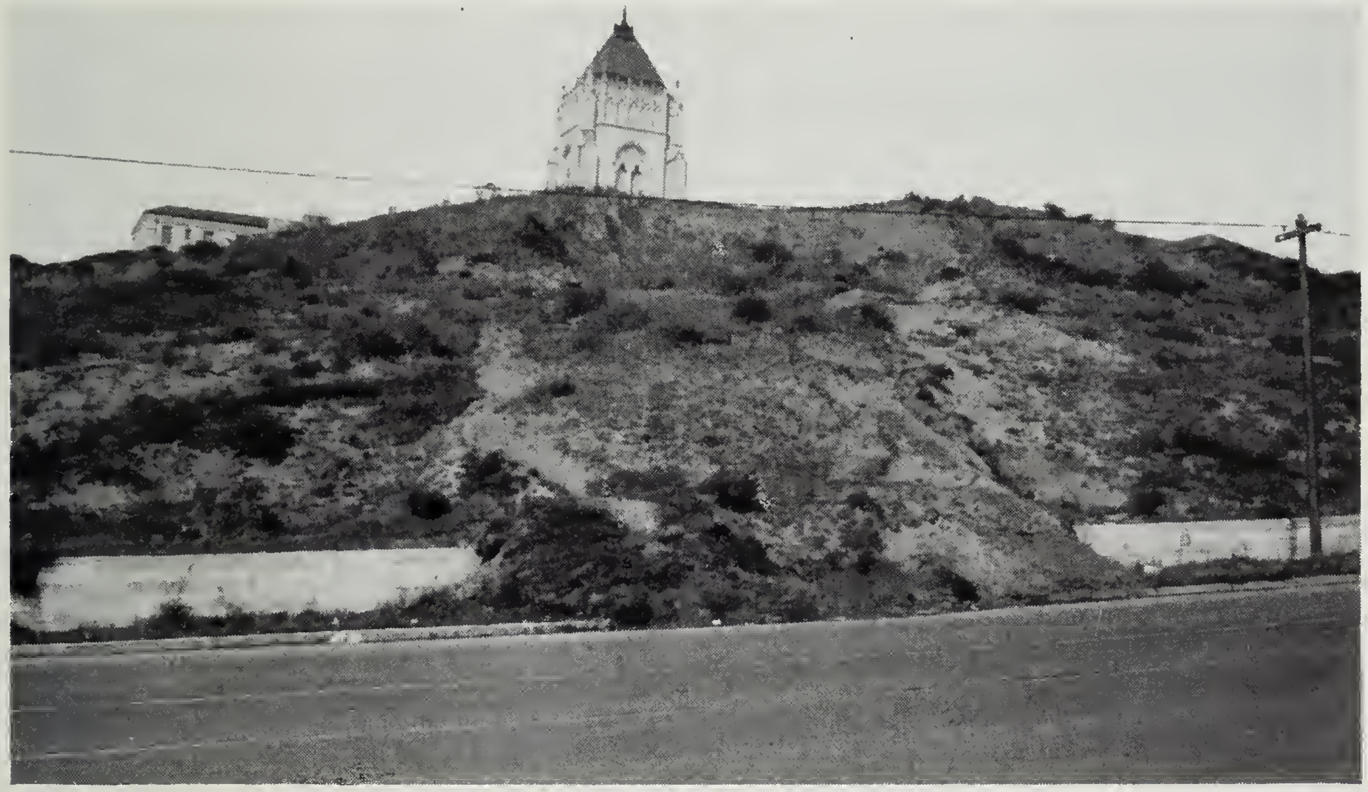

FIG. 12. Landslide "A" along Turk Street

structure a tendency toward a denser state of packing. The voids in the mass of sand were completely filled with water. The reduction in volume during deformation was accompanied by an outflow of an equivalent amount of water. Because the water could not escape quickly enough, the volume decrease lagged noticeably behind that which would have taken place had no water been present. Consequently a hydro-dynamic stress was induced, and the pressure between the grains was transferred in part or entirely onto the water. This led to a condition in the mass of little or no resistance to shear or a state of liquefaction, and the landslides followed. The flow-like character of Landslide A is well illustrated in Fig. 12.

This phenomenon is admirably demonstrated by means of an experiment described by Casagrande.[3]

> "In the tank shown * * * is deposited a fine quartz sand in a loose, saturated state, with free water standing on its surface, and a weight is placed on the surface. Then a stick is thrust into the sand, and suddenly the weight sinks below the surface. The slight but rapid deformation produced by the penetration of the stick results in a change of the sand structure and the formation of hydrodynamic stresses which quickly spread through the entire mass and so decrease the internal friction that the weight can no longer be supported.
>
> "This experiment can be made even more striking by letting water percolate in an upward direction through the sand, which changes it into an exceedingly loose state, and then draining away all water from the surface, so that capillary forces will be mobilized. In this state the surface can support a heavy weight without noticeable subsidence. Upon driving the stick into the sand under these conditions the whole mass seems to liquefy suddenly and the weight disappears completely. In this case the liberation of water due to deformation produces, as a secondary effect, the disappearance of the capillary forces which helped materially in carrying the load. * * *
>
> "Contrary to the belief of many engineers that a mass of sand will always be stable if the slope is less than the angle of repose, there are many examples on record of embankments, dikes, etc., consisting of fine, saturated sands, being destroyed by flowing out of the entire mass as if it had been suddenly liquefied."

Acknowledgments.

The writer wishes to express his appreciation to John J. Casey, city engineer of San Francisco, for making available topographic survey data of the Parker Avenue slide.

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[3] Casagrande, Arthur, Characteristics of cohesionless soils affecting the stability of slopes and earth fills: Boston Soc. Civil Eng. Journal, vol. 23, no. 1, pp. 13–32, 1936.

APPENDIX A

For determining the coefficients of friction and cohesion the principles and method described below were followed. Coulomb in 1781 formulated the laws which act in masses of homogeneous earth. As stated by William Cain they are:

> "Law 1. The maximum frictional resistance along any portion of a plane in the interior of a mass of earth equals the normal pressure on the portion of the plane considered, multiplied by f, the coefficient of friction, where f is a constant for the earth considered. The friction is thus independent of the area pressed.
>
> "Law 2. The maximum cohesion equals the area considered under compression, multiplied by a constant c, the coefficient of cohesion or cohesion per area. The cohesion is thus independent of the normal pressure." [4]

The shape of the slip-surface was assumed to be cylindrical for a section of unit thickness taken through the slide. This assumption is based on the work of Petterson.[5] It has been checked by thorough field investigations and found to be approximately correct.[6]

Graphical methods were used to determine the coefficients of cohesion and friction that had acted when motion of the land mass was imminent. The original ground profile was reconstructed from survey data gathered in the field, and a series of possible slip-curves, C_1, C_2 and C_3 were drawn. (Fig. 3.) Curve C_2 represents the approximate curve along which the land mass is presumed to have slipped. It passes through the outer edge of the mound that was thrust up at the base of Lone Mountain and along the exposed portion of the slip-surface represented by the escarpment at the upper edge of the slide. The center of gravity for the section as bounded by each slip-curve was located experimentally. The weight, W, of the section was graphically represented as a vector acting on the slip-curve along a line passing vertically through the center of gravity. (Fig. 13.) At the point of intersection with the slip-curve, the vertical reaction, Q, was resolved into two components, a normal force N, and a tangential force R. R represents the combined resistance of cohesion and friction necessary for equilibrium along the slip-surface.

$$R = Lc + N \tan \phi \qquad \text{[Equation 1.]}$$

L = length of slip-curve
c = coefficient of cohesion
$\tan \phi$ = coefficient of friction

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[4] Cain, William, Earth pressure, walls and bins: John Wiley and Sons, New York, 1916.

[5] Petterson, K. E., Kajraset i Goteborg den 5 : te mars 1916 : Tekn. Tidskr., V. U., Heft 30, S. 281–287 ; Heft 31, S. 289–291, Stockholm, 1916.

[6] Statens Jarnvagars Geotekniska Kommission, Slutbetankande 31, Sweden, May 1922.

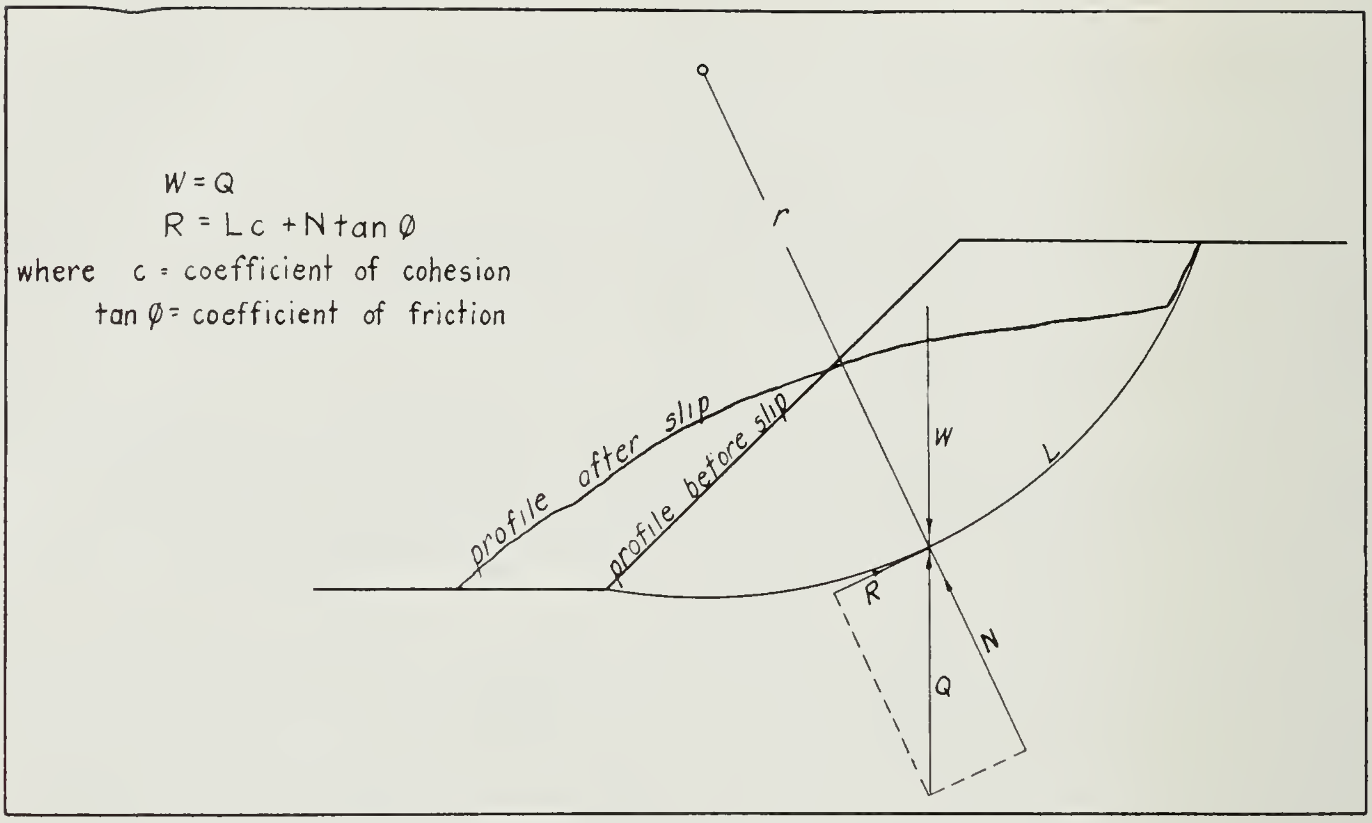
W = Q
R = Lc + N tan ∅
where c = coefficient of cohesion
tan ∅ = coefficient of friction
r
profile after slip
profile before slip
W
L
R
N
Q

FIG. 13. Forces acting on section to maintain equilibrium

For determining ϕ and c a method described by Terzaghi was used.[7] A series of values for ϕ was assumed and a corresponding series of c values was computed for each slip-curve, using equation 1. The distances betweeen the centers, O_1, O_2, and O_3 of the various slip-curves were plotted as abscissas. (Fig. 3.) For each slip-curve the values of c corresponding to different assumed ϕ values were plotted as ordinates. The points corresponding to the same value of ϕ were joined in a curve. Each curve shows a maximum point. The abscissa passing through a maximum represents the position of the center of the most dangerous slip-arc for material possessing the given ϕ value. The curve whose maximum falls on the abscissa of the actual slip-arc serves to determine the values of ϕ and c that acted when sliding was imminent.

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[7] Terzaghi, Charles, The mechanics of shear failures on clay slopes and the creep of retaining walls: Public Roads, vol. 10, no. 10, pp. 177–192, 1929.

APPENDIX B

The principal laboratory test was to determine the angle of internal friction possessed by various samples of ground. For this purpose apparatus of brass was constructed. (Fig. 14.) It consists of two rings which contain the sample and fit into an upper and lower block respectively. A plate fits into the upper ring and rests on the sample. A load may be transmitted to the sample through this plate by means of a lever A. The upper block is held stationary. The lower block is free to roll on bearings except for the resistance to shear exerted by the sample being tested. A shearing force may be applied by means of lever B.

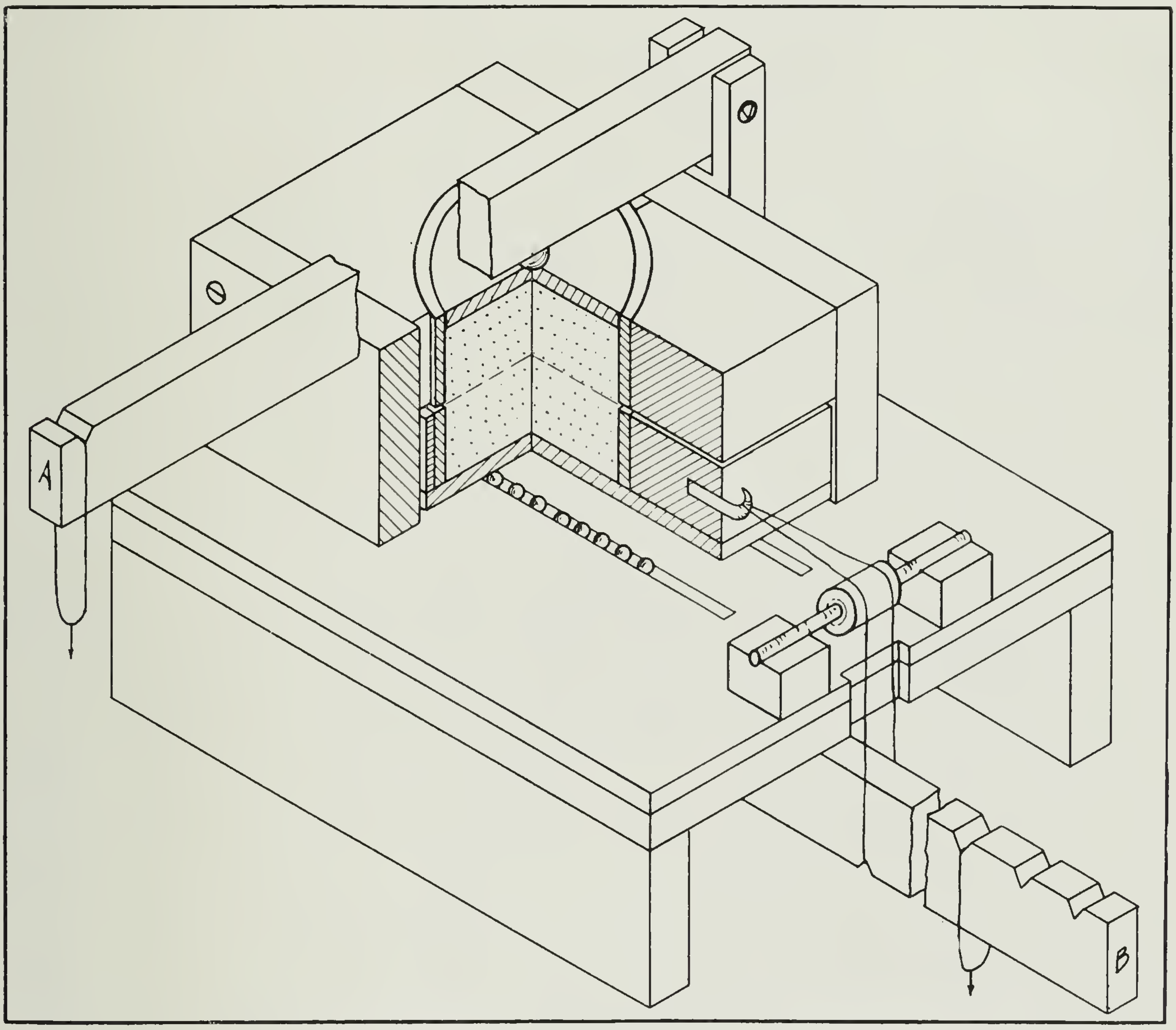


FIG. 14. Isometric sketch of shearing apparatus

A sample of the material to be tested was disintegrated with the hands or a rubber-covered pestle until it passed through a number 10 mesh screen. Water was added and a paste was made of the material. It was then pressed into the rings of the shearing apparatus and allowed to dry for one or two days, after which it was sheared. In this way a smooth, sheared surface was developed between the substance in the upper and lower rings. The rings containing the sample were then placed in juxtaposition, and contact between the contained material was made along the smooth surface. The sample was loaded normal to the slip-plane, and the shearing force required to produce movement was measured. The results were plotted, normal loads as abscissas and shearing forces as ordinates. These curves approximate straight lines. The slope of the curve is the angle of internal friction.

The ordinate for the extrapolated curve, where the abscissa is zero, is the value of the cohesive force for the material along the sheared surface. The maximum applied normal load was 13 lbs. per square inch, which is equivalent to the pressure at a depth of about 15 feet.

PARKER AVENUE LANDSLIDE

$$R = L\,c + N \tan \varnothing \quad \text{(See Fig. 13.)}$$

$$c = \frac{R - N \tan \varnothing}{L}$$

R=total resistance along curve
N=total normal force acting at "g"
L=length of curve in feet
c=coefficient of cohesion
tan ∅=coefficient of friction

TABLE 1

Slipcurve	R	N	L	∅	tan ∅	c
C_1	4.75K*	17.15K	412 ft.	10°	.1763	.00420 K
				12°	.2126	.00267 K
				15°	.2679	.000364K
C_2	7.80K	26.35K	434 ft.	10°	.1763	.00715 K
				12°	.2126	.00506 K
				15°	.2679	.00184 K
C_3	10.9 K	40.35K	467 ft.	10°	.1763	.00814 K
				12°	.2126	.00493 K
				15°	.2679	.000214K

* K=53,400 lbs.

TABLE 2
TURK STREET LANDSLIDE A—SAN FRANCISCO

Slipcurve	R	N	L	∅	tan ∅	c
C_1	3.5K*	10.0K	146 ft.	12°	.2126	.00956K
				15°	.2679	.00548K
				17°	.3057	.00302K
				18°	.3249	.00171K
C_2	6.6K	18.5K	166 ft.	12°	.2126	.0162 K
				15°	.2679	.0102 K
				17°	.3057	.00603K
				18°	.3249	.00361K
C_3	10.2K	30.8K	185 ft.	12°	.2126	.0195 K
				15°	.2679	.0103 K
				17°	.3057	.00433K
				18°	.3249	.00108K

* K=13,320 lbs.
See Table 1 for explanation of symbols.

TABLE 3
TURK STREET LANDSLIDE B—SAN FRANCISCO

Slipcurve	R	N	L	∅	tan ∅	c
C_1	4.8K*	13.1K	133 ft.	10°	.1763	.0188 K
				12°	.2126	.0150 K
				14°	.2493	.0113 K
				16°	.2867	.00752K
C_2	6.6K	19.7K	144 ft.	10°	.1763	.0215 K
				12°	.2126	.0167 K
				14°	.2493	.0118 K
				16°	.2867	.00625K
C_3	8.5K	28.5K	160 ft.	10°	.1763	.0218 K
				12°	.2126	.0150 K
				14°	.2493	.00875K
				16°	.2867	.00188K
C_4	10.5K	40.2K	177 ft.	10°	.1763	.0192 K
				12°	.2126	.0113 K
				14°	.2493	.00282K
				16°	.2867	.00565K

* K=13,320 lbs.
See Table 1 for explanation of symbols.

OIL FIELD DEVELOPMENT OPERATIONS

R. D. Bush, State Oil and Gas Supervisor

From June 28, 1936, to and including October 3, 1936, the following new wells were reported as ready to drill:

Company	Sec.	Twp.	Range	Well No.	Field
ALAMEDA COUNTY:					
Seaboard Oil Corp.	13	3 S.	3 E.	Johnston 1	
COLUSA COUNTY:					
Birch Ranch and Oil Co. and Irwin S. Burgess	25	15 N.	4 W.	Stovall-Wilcoxson 2	
FRESNO COUNTY:					
Kettleman North Dome Assoc.	28	21 S.	17 E.	63	Kettleman North Dome
Kettleman North Dome Assoc.	30	21 S.	17 E.	52	Kettleman North Dome
Kettleman North Dome Assoc.	32	21 S.	17 E.	81	Kettleman North Dome
Kettleman North Dome Assoc.	32	21 S.	17 E.	85	Kettleman North Dome
Kettleman North Dome Assoc.	34	21 S.	17 E.	52	Kettleman North Dome
Kettleman North Dome Assoc.	34	21 S.	17 E.	72	Kettleman North Dome
Standard Oil Co.	13	21 S.	16 E.	46	Kettleman North Dome
Standard Oil Co.	19	21 S.	17 E.	2	Kettleman North Dome
HUMBOLDT COUNTY:					
H. M. Anthony, Edna A. Wilson and W. C. Werle	12	1 S.	3 W.	1	
North Counties Oil Co.	36	2 S.	1 W.	3	
IMPERIAL COUNTY:					
Imperial Carb-Ice Corp.	2	11 S.	13 E.	4	
KERN COUNTY:					
Belridge Oil Co.	35	27 S.	20 E.	15-35	Belridge
Belridge Oil Co.	1	28 S.	20 E.	5-1	Belridge
Belridge Oil Co.	1	28 S.	20 E.	12-1	Belridge
Continental Oil Co.	36	27 S.	20 E.	Result 8	Belridge
Shell Oil Co.	5	28 S.	20 E.	Voigt Three 1	Belridge
Den Petroleum, Inc.	20	25 S.	19 E.	1	Devils Den
Berry Holding Co.	10	30 S.	29 E.	Grayson 3	Edison
Buffalo Oil Co.	24	30 S.	29 E.	Buffalo-Wildman 2	Edison
Cole, Drais, Martter and Wood, Inc.	24	30 S.	29 E.	Ross 1	Edison
A. T. Jergins Trust	23	30 S.	29 E.	Jergins-Texas Fee 23 4	Edison
A. T. Jergins Trust	23	30 S.	29 E.	Jergins-Texas Fee 23 5	Edison
A. T. Jergins Trust	23	30 S.	29 E.	Jergins-Texas Fee 23 7A	Edison
A. T. Jergins Trust	24	30 S.	29 E.	Smithwick 4	Edison
W. E. Marley, Jr.	19	30 S.	30 E.	Marley 1	Edison
The Ohio Oil Co.	4	30 S.	29 E.	Edison-Seale 4-1	Edison
Wood-Callahan Oil Co., Ltd.	23	30 S.	29 E.	Gerard 2	Edison
Wood-Callahan Oil Co., Ltd.	23	30 S.	29 E.	Gerard 3	Edison
Bilgrad Oil Co.	21	29 S.	27 E.	Bilgrad 1	Fruitvale
Dixie Lee Oil Co.	23	29 S.	27 E.	Dixie Lee 5	Fruitvale
Elbee Petroleum Co.	23	29 S.	27 E.	Bitner 1	Fruitvale
Exeter Oil Co., Ltd.	21	29 S.	27 E.	Henry 1	Fruitvale
W. F. Higgins	21	29 S.	27 E.	Higgins 10	Fruitvale
Geo. K. Linderman	28	29 S.	27 E.	Linderman 1	Fruitvale
Magnet Oil Co.	21	29 S.	27 E.	Anderson 3	Fruitvale
Magnet Oil Co.	21	29 S.	27 E.	Seymour 2	Fruitvale
Miami Oil Co.	21	29 S.	27 E.	Miami 1	Fruitvale
Mohawk Petroleum Co.	11	29 S.	27 E.	KCL-11 1	Fruitvale
Mohawk Petroleum Co.	23	29 S.	27 E.	K. C. L. 23 2	Fruitvale
Mohawk Petroleum Co.	23	29 S.	27 E.	K. C. L. 23 3	Fruitvale
Nydia Petroleum Co.	26	29 S.	27 E.	Harding 1	Fruitvale
Oil Incorporated	26	29 S.	27 E.	O 1	Fruitvale
Western Gulf Oil Co.	21	29 S.	27 E.	A. C. West 1	Fruitvale
Western Gulf Oil Co.	21	29 S.	27 E.	Edward West 2	Fruitvale
Western Gulf Oil Co.	21	29 S.	27 E.	Lahore 2	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Red Ribbon Ranch 4	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Red Ribbon Ranch 5	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Red Ribbon Ranch 6	Fruitvale
Western Gulf Oil Co.	27	29 S.	27 E.	Sawyer & Reed 2	Fruitvale
Sy Wicker	15	29 S.	27 E.	Krebs 1	Fruitvale
Associated Oil Co.	23	28 S.	27 E.	21	Kern River
Associated Oil Co.	23	28 S.	27 E	31	Kern River

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued					
Associated Oil Co.	23	28 S.	27 E.	41	Kern River
Big Eleven Oil Co.	18	28 S.	28 E.	Big Eleven 1	Kern River
C. C. M. O. Co.	23	28 S.	27 E.	50	Kern River
General Petroleum Corp.	14	28 S.	27 E.	Young 38	Kern River
General Petroleum Corp.	14	28 S.	27 E.	Young 39	Kern River
Hope Oil Co.	8	29 S.	28 E.	Golden Rod 6	Kern River
Italo Petroleum Corp.	16	28 S.	27 E.	Cauley 33	Kern River
Chas. H. Kaar	26	28 S.	27 E.	Watterson 1	Kern River
Alvah M. Kaime	17	28 S.	27 E.	Sesnon 1	Kern River
The Kern River Oilfields of Calif., Ltd.	25	28 S.	27 E.	25-2B	Kern River
McDonald and Dearin	11	28 S.	27 E.	3	Kern River
Republic Petroleum Co.	11	28 S.	27 E.	Fleisbhacker 4	Kern River
Republic Petroleum Co.	11	28 S.	27 E.	Fleishhacker 5	Kern River
Republic Petroleum Co.	24	28 S.	27 E.	Strassburger 11	Kern River
Union Oil Co.	11	28 S.	27 E.	Perseus 1	Kern River
Associated Oil Co.	1	26 S.	20 E.	Taylor 1	Lost Hills
Associated Oil Co.	2	26 S.	20 E.	Williamson 3	Lost Hills
Associated Oil Co.	2	26 S.	20 E.	Williamson 4	Lost Hills
Associated Oil Co.	11	26 S.	20 E.	12-A-3	Lost Hills
Lincoln Petroleum Co.	12	26 S.	20 E.	Theta 2	Lost Hills
The Texas Co.	11	26 S.	20 E.	Theta 1	Lost Hills
Universal Consolidated Oil Co.	20	26 S.	21 E.	Helm 1	Lost Hills
West Coast Oil Co.	2	26 S.	20 E.	6-L-3	Lost Hills
Hoke Woodward	11	30 S.	21 E.	MacDonald 6	McKittrick
Associated Oil Co.	35	21 S.	22 E.	7	Midway
Berry & Ewing	31	32 S.	24 E.	3	Midway
Big Ten Oil Co.	36	32 S.	23 E.	14	Midway
Birch Ranch & Oil Co.	22	32 S.	23 E.	Goldman 1	Midway
Burkholder Oil Corp.	23	32 S.	23 E.	Orloff 2	Midway
C. C. M. O. Co.	21	32 S.	23 E.	18	Midway
C. C. M. O. Co.	21	32 S.	23 E.	19	Midway
C. C. M. O. Co.	21	32 S.	23 E.	20	Midway
Frank Goldman	22	32 S.	23 E.	Keene 3	Midway
Honolulu Oil Corp., Ltd	14	32 S.	24 E.	6	Midway
R. W. Jerman and Associates	17	31 S.	23 E.	Juster 1	Midway
North American Oil Consolidated	2	32 S.	24 E.	3	Midway
Pan American Petroleum Co.	22	32 S.	23 E.	Buena Fe 66	Midway
E. L. Pilling	34	32 S.	24 E.	1	Midway
Pomoc Oil Co.	15	32 S.	23 E.	Perris 8	Midway
Quality Oil Co.	22	32 S.	23 E.	Bull 3	Midway
Quality Oil Co.	27	32 S.	23 E.	W. P. 3	Midway
Safeway Oil Co.	26	32 S.	23 E.	1	Midway
Standard Oil Co.	33	32 S.	24 E.	8	Midway
Standard Oil Co.	33	32 S.	24 E.	9	Midway
Standard Oil Co.	33	32 S.	24 E.	20	Midway
Standard Oil Co.	33	32 S.	24 E.	216	Midway
Standard Oil Co.	33	32 S.	24 E.	219	Midway
The Texas Co.	32	32 S.	24 E.	16	Midway
Union Oil Co.	22	32 S.	23 E.	Keene 2	Midway
Union Oil Co.	22	32 S.	23 E.	Keene 3	Midway
Union Oil Co.	22	32 S.	23 E.	Williams 2	Midway
Carl E. Zamloch	22	32 S.	23 E.	1	Midway
J. J. Chevalier	3	27 S.	28 E.	Southern Pacific 2	Mt. Poso
General Petroleum Corp.	16	27 S.	28 E.	Heisen 8	Mt. Poso
Frank Goldman	35	27 S.	28 E.	Glide 2	Mt. Poso
E. J. Harp	27	26 S.	28 E.	Harp 2	Mt. Poso
R. S. Lytle	26	27 S.	28 E.	Dorsey 4	Mt. Poso
Ring Oil Co., Ltd.	28	26 S.	28 E.	Knapp 1	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 27	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 28	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 29	Mt. Poso
Shell Oil Co.	9	27 S.	28 E.	Vedder 30	Mt. Poso
Shell Oil Co.	16	27 S.	28 E.	Security 15	Mt. Poso
Shell Oil Co.	16	27 S.	28 E.	Security 16	Mt. Poso
Shell Oil Co.	16	27 S.	28 E.	Security 17	Mt. Poso
Shell Oil Co.	16	27 S.	28 E.	Security 18	Mt. Poso
Union Oil Co.	28	27 S.	28 E.	Tribe B-1	Mt. Poso
Vanguard Oil Co.	33	27 S.	28 E.	Baker 5	Mt. Poso
Allied Petroleum Corp.	19	30 S.	29 E.	Allied 20	Mountain View
Associated Oil Co.	3	31 S.	29 E.	Di Giorgio 2	Mountain View
Barnsdall Oil Co.	19	30 S.	29 E.	Nighbert 1	Mountain View
Buffalo Oil Co.	19	30 S.	20 E.	Buffalo 4	Mountain View
Hogan Petroleum Co.	29	30 S.	29 E.	Porter-Day 8	Mountain View
Hogan Petroleum Co.	32	30 S.	29 E.	Foster Comm. 5	Mountain View
Hogan Petroleum Co.	32	30 S.	29 E.	Wharton 7	Mountain View
Hogan Petroleum Co.	5	31 S.	29 E.	Peters 2	Mountain View
Mid State Petroleum Co.	19	30 S.	29 E.	1	Mountain View
Mohawk Petroleum Co.	30	30 S.	29 E.	Clendenen 8	Mountain View
Sheldon Oil Corp.	19	30 S.	29 E.	Ross 2	Mountain View
Shell Oil Co.	32	30 S.	29 E.	Porter Two 10	Mountain View
Shell Oil Co.	32	30 S.	29 E.	Porter Two 11	Mountain View

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
KERN COUNTY—Continued					
Standard Oil Co.	13	30 S.	28 E.	Calif. Lands, Inc. 2	Mountain View
Standard Oil Co.	13	30 S.	28 E.	Warren 2	Mountain View
Standard Oil Co.	18	30 S.	29 E.	Mabry 2	Mountain View
Wood-Callahan Oil Co., Ltd.	24	30 S.	28 E.	Mullaney 1	Mountain View
Bargol Oil Co., Ltd.	11	27 S.	27 E.	Bargol 2	Poso Creek
Alphonzo E. Bell Corp.	14	27 S.	27 E.	Fitzhugh 1	Poso Creek
Alphonzo E. Bell Corp.	14	27 S.	27 E.	Fitzhugh 2	Poso Creek
Bethlehem Exploration Co.	10	27 S.	27 E.	Siemon 2	Poso Creek
Honolulu Oil Corp., Ltd.	8	28 S.	27 E.	89	Poso Creek
Rex Oil Co.	4	28 S.	27 E.	Mabry 2	Poso Creek
Barnsdall Oil Co.	7	28 S.	29 E.	Caldwell 8	Round Mountain
Barnsdall Oil Co.	7	28 S.	29 E.	Caldwell 9	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	37	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	54	Round Mountain
Honolulu Oil Corp., Ltd.	18	28 S.	29 E.	J	Round Mountain
Honolulu Oil Corp., Ltd.	20	28 S.	29 E.	12	Round Mountain
Shell Oil Co.	7	28 S.	29 E.	Caldwell 10	Round Mountain
Shell Oil Co.	7	28 S.	29 E.	Caldwell 15	Round Mountain
Shell Oil Co.	17	28 S.	29 E.	Olcese 1 6	Round Mountain
Shell Oil Co.	17	28 S.	29 E.	Olcese 1 7	Round Mountain
Shell Oil Co.	17	28 S.	29 E.	Olcese 1 8	Round Mountain
Shell Oil Co.	17	28 S.	29 E.	Olcese 1 9	Round Mountain
Shell Oil Co.	20	28 S.	29 E.	Freeman 11	Round Mountain
Alford Oil Co.	25	12 N.	24 W.	Fried 5	Sunset
Alford Oil Co.	25	12 N.	24 W.	Fried 6	Sunset
Five Points Petroleum Corp.	18	11 S.	23 E.	Five Points 2	Sunset
Hallmark Oil Co., Inc.	25	12 N.	24 W.	5	Sunset
Otis Hoyt	7	11 N.	23 W.	Otis Hoyt-Maricopa 2	Sunset
Otis Hoyt	7	11 N.	23 W.	Otis Hoyt-Maricopa 3	Sunset
Merritt Annex Oil Co.	25	12 N.	24 W.	Fried 1	Sunset
Sheppard Oil Co.	12	11 N.	24 W.	Sheppard 1	Sunset
Standard Oil Co.	26	12 N.	24 W.	Monarch 18	Sunset
Union Oil Co.	7	11 N.	23 W.	Midway Northern 1	Sunset
The Ohio Oil Co.	19	30 S.	26 E.	KCL–E 1	Ten Section
Shell Oil Co.	29	30 S.	26 E.	KCL–A 6–29	Ten Section
Standard Oil Co.	20	30 S.	26 E.	K. C. 10 1	Ten Section
Standard Oil Co.	34	30 S.	26 E.	K. C. 9 1	Ten Section
Arkelo Petroleum Co.	23	28 S.	26 E.	Arkelo 41	
Associated Oil Co.	30	29 S.	25 E.	1	
C. C. M. O. Co.	28	32 S.	23 E.	1	
Doyle Petroleum Corp.	15	25 S.	27 E.	Quinn 1	
East Edison Oil Co.	21	30 S.	30 E.	1	
General Petroleum Corp.	26	31 S.	29 E.	Arvin 1	
Mohawk Petroleum Co.	10	31 S.	29 E.	Earl Fruit Co. 2	
The Ohio Oil Co.	21	11 N.	19 W.	T. I. T. D–1	
The Ohio Oil Co.	4	32 S.	26 E.	K. C. L. B–1	
Shell Oil Co.	15	31 S.	29 E.	Greer 1	
Standard Oil Co.	19	29 S.	26 E.	K. C. 11 1	
Superior Oil Co.	11	30 S.	26 E.	K. C. L. 8	
KINGS COUNTY:					
Standard Oil Co.	19	23 S.	19 E.	46	Kettleman Middle Dome
LOS ANGELES COUNTY:					
Continental Oil Co.	20	3 S.	9 W.	Carlton Comm. 2	Coyote Hills
The Hancock Oil Co.	17	3 S.	9 W.	Page 1	Coyote Hills
R. A. Rowan, E. S. Armstrong and Jas. E. Babcock	21	3 S.	9 W.	May 1	Coyote Hills
Shell Oil Co.	33	3 S.	13 W.	Reyes 86	Dominguez
Union Oil Co.	33	3 S.	13 W.	Callender 49	Dominguez
Union Oil Co.	33	3 S.	13 W.	Callender 50	Dominguez
Union Oil Co.	33	3 S.	13 W.	Hellman 44	Dominguez
Associated Oil Co.	7	2 S.	14 W.	Vickers 51	Inglewood
Kettleman and Inglewood Corp.	8	2 S.	14 W.	Rubel 24	Inglewood
Shell Oil Co.	8	2 S.	14 W.	Rindge 21	Inglewood
Standard Oil Co.	8	2 S.	14 W.	L. A. Investment Lease 79	Inglewood
Standard Oil Co.	8	2 S.	14 W.	L. A. Investment Lease 80	Inglewood
Hollis Oil Co.	29	4 S.	12 W.	1	Long Beach
Shell Oil Co.	29	4 S.	12 W.	Alamitos 43	Long Beach
The Texas Co.	19	4 S.	12 W.	Field 20	Long Beach
Republic Petroleum Co.	6	2 S.	11 W.	Republic Fee 1	Montebello
Richfield Oil Co.	5	2 S.	11 W.	Estrada 1	Montebello
The St. Helens Petroleum Co., Ltd.	6	2 S.	11 W.	Piuma-Briano 8	Montebello
The St. Helens Petroleum Co., Ltd.	2	2 S.	12 W.	Monterey 19	Montebello
The St. Helens Petroleum Co., Ltd.	2	2 S.	12 W.	Monterey 20	Montebello
The St. Helens Petroleum Co., Ltd.	2	2 S.	12 W.	Monterey 21	Montebello
Standard Oil Co.	1	2 S.	12 W.	Baldwin 87	Montebello

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
LOS ANGELES COUNTY—Continued:					
Standard Oil Co.	1	2 S.	12 W.	Baldwin 88	Montebello
Standard Oil Co.	1	2 S.	12 W.	Baldwin 89	Montebello
The Texas Co.	6	2 S.	11 W.	Baldwin 14	Montebello
The Texas Co.	6	2 S.	11 W.	Baldwin 15	Montebello
Holbrook Petroleum Corp.	28	4 N.	16 W.	Broughton 1	Newhall
Yant Petroleum Corp.	1	3 N.	16 W.	Yant 6	Newhall
Sharby Oil Co.	22	2 S.	15 W.	Sharby 1	Playa del Rey
Union Oil Co.	27	2 S.	15 W.	King Vidor 17	Playa del Rey
Santa Rita Oil Co.	20	3 S.	13 W.	Santa Rita 1	Rosecrans
Union Oil Co.	6	3 S.	11 W.	Alexander 31	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Alexander 33	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Alexander 34	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Alexander 35	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Alexander 36	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 98	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 100	Santa Fe Springs
Union Oil Co.	6	3 S.	11 W.	Bell 101	Santa Fe Springs
Union Oil Co.	31	2 S.	11 W.	Bell 102	Santa Fe Springs
Vanda Petroleum Co.	4	3 S.	11 W.	Vanda 1	Santa Fe Springs
Black Gold Corp.	6	4 S.	14 W.	Black Gold 1	Torrance
California Reserve Oil Co.	6	4 S.	14 W.	California Reserve 1	Torrance
Tirey L. Ford	6	4 S.	14 W.	Water Service Co. 1	Torrance
Geo. K. Linderman Oil Corp.	31	3 S.	14 W.	3	Torrance
M. W. Petroleum Co.	6	4 S.	14 W.	M. W. 1	Torrance
Marshall Oil Co.	31	3 S.	14 W.	1	Torrance
The Petrol Corp.	5	4 S.	14 W.	Simmons 2	Torrance
The Petrol Corp.	6	4 S.	14 W.	Simmons 3	Torrance
The Petrol Corp.	6	4 S.	14 W.	Simmons 4	Torrance
Gus Pongratz	8	4 S.	14 W.	Vaccaro 1	Torrance
Gus Pongratz	8	4 S.	14 W.	Vaccaro 2	Torrance
Shell Oil Co.	32	3 S.	14 W.	Kranz 1	Torrance
Walken Oil Co.	5	4 S.	14 W.	2	Torrance
Walken Oil Co.	5	4 S.	14 W.	3	Torrance
R. R. Bush Oil Co.	4	2 S.	11 W.	Pellissier 1	Whittier
Bankline Oil Co.	34	4 S.	13 W.	Dominguez Harbor Comm. 1	Wilmington
Gauthier Oil Co.	27	4 S.	13 W.	Classification Yd. 1	Wilmington
A. T. Jergins Trust	34	4 S.	13 W.	Wilmington 4-A	Wilmington
A. T. Jergins Trust	34	4 S.	13 W.	Wilmington 5	Wilmington
A. T. Jergins Trust	34	4 S.	13 W.	Wilmington 6	Wilmington
A. T. Jergins Trust	34	4 S.	13 W.	Wilmington 12	Wilmington
Pan American Petroleum Co.	20	4 S.	13 W.	Kleinmeyer 1-C	Wilmington
Royalty Service Corp., Ltd.	28	4 S.	13 W.	Banning 11-1	Wilmington
Royalty Service Corp., Ltd.	28	4 S.	13 W.	Banning 10-1	Wilmington
Sovereign Oil Corp.	28	4 S.	13 W.	Sovereign Advance Truck 1	Wilmington
Sovereign Oil Corp.	28	4 S.	13 W.	Sovereign Advance Truck 2	Wilmington
Sunset Oil Co.	28	4 S.	13 W.	Lupie 2	Wilmington
Barnsdall Oil Co.	26	4 N.	17 W.	Rancho San Francisco 1	
George L. Clayton	5	4 S.	12 W.	Clayton 1	
Republic Petroleum Co.	24	1 S.	13 W.	Jordan 1	
Richfield Oil Co.	18	3 S.	14 W.	El Segundo 1	
Superior Oil Co.	25	2 S.	15 W.	Inglewood Extension 1	
Universal Consolidated Oil Co.	36	3 S.	14 W.	Carrell 1	
West American Oil Co.	5	4 S.	13 W.	Dominguez Estates 1	
MADERA COUNTY:					
The Pure Oil Co.	12	10 S.	13 E.	Chowchilla 5	
MERCED COUNTY:					
San Joaquin Oil Co.	1	12 S.	11 E.	1	
MONTEREY COUNTY:					
Central Valley Petroleum Co.	22	20 S.	12 E.	Hart 1	
Shell Oil Co.	34	24 S.	10 E.	Branch 2	
NAPA COUNTY:					
Lincoln & Kuhns	29	8 N.	3 W.	1	
ORANGE COUNTY:					
Shell Oil Co.	2	3 S.	10 W.	Orange 19	Brea-Olinda
Associated Oil Co.	34	5 S.	11 W.	Miley-Keck 53	Huntington Beach
W. M. Elliott Co.	2	6 S.	11 W.	1	Huntington Beach
Huntington Signal Oil Co.	2	6 S.	11 W.	Bronson 1	Huntington Beach
Lucky Strike Oil Co., Ltd.	2	6 S.	11 W.	6	Huntington Beach

OIL FIELD DEVELOPMENT OPERATIONS—Continued

Company	Sec.	Twp.	Range	Well No.	Field
ORANGE COUNTY—Continued:					
Vicaroo Oil Co.	10	6 S.	11 W.	S & G 1-A	Huntington Beach
W. C. W. Drilling Co.	35	5 S.	11 W.	W. C. W. 2	Huntington Beach
Westport Oil Co.	2	6 S.	11 W.	5	Huntington Beach
Union Oil Co.	29	3 S.	9 W.	Chapman 34	Richfield
Union Oil Co.	29	3 S.	9 W.	Chapman 35	Richfield
Union Oil Co.	29	3 S.	9 W.	Chapman 36	Richfield
Union Oil Co.	29	3 S.	9 W.	Chapman 37	Richfield
Union Oil Co.	29	3 S.	9 W.	Chapman 38	Richfield
Union Oil Co.	30	3 S.	9 W.	Chapman 33	Richfield
West Coast Refining Co.	25	3 S.	9 W.	Yorba Comm. 1	Richfield
SAN BENITO COUNTY:					
Associated Oil Co.	5	12 S.	4 E.	Murphey 1	
SAN BERNARDINO COUNTY:					
Melbourne Oil Co.	12	3 S.	8 W.	Abacherli 2	
U. A. Development Co.	14	4 N.	1 W.	Lucerne Valley 1	
SAN JOAQUIN COUNTY:					
Standard Oil Co.	31	2 N.	5 E.	Mabrey Comm. 1	
SAN LUIS OBISPO COUNTY:					
A. T. Jergins Trust	5	32 S.	13 E.	Rodrigues 1	Arroyo Grande
R. W. McBurney	23	32 S.	22 E.	McBurney 1	
Union Oil Co.	--	11 N.	35 W.	Union Sugar 1	
Union Oil Co.	--	11 N.	35 W.	Union Sugar 2	
Union Oil Co.	--	10 N.	35 W.	Union Sugar 3	
Union Oil Co.	22	32 S.	15 E.	Porter 1	
SANTA BARBARA COUNTY:					
General Petroleum Corp.	32	5 N.	30 W.	Erburu 16	Capitan
General Petroleum Corp.	32	5 N.	30 W.	Erburu 19	Capitan
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 1 16	Capitan
Shell Oil Co.	32	5 N.	30 W.	Covarrubias 1 18	Capitan
Shell Oil Co.	32	5 N.	30 W.	Orella 4	Capitan
Todos Santos Oil Co.	29	9 N.	34 W.	Todos Santos 1	Casmalia
O. C. Field Gasoline Corp.	21	9 N.	33 W.	1	Cat Canyon
Signal Oil and Gas Co.	16	4 N.	29 W.	Appleford 98 8	Elwood
Dyak Exploration Co., Ltd.	28	4 N.	27 W.	Dyak 1	Mesa
Apache Oil Co.	31	9 N.	33 W.	1	Santa Maria
Union Oil Co.	26	9 N.	34 W.	Squires 16	Santa Maria
R. R. Bush Oil Co.	25	10 N.	34 W.	Hancock-Bush, Brown 1	
La Canada Oil Corp.	3	4 N.	30 W.	Rhode Island Estates 2	
The Texas Co.	--	4 N.	30 W.	Rutherford 1	
Union Oil Co.	24	10 N.	34 W.	Battles 2	
Union Oil Co.	24	10 N.	34 W.	Bettiga 1	
Union Oil Co.	24	10 N.	34 W.	Mahoney 1	
Valley Oil Co.	18	10 N.	33 W.	Rice 1	
SOLANO COUNTY:					
Amerada Petroleum Corp.	22	4 N.	2 E.	Happe 1	
Standard Oil Co.	27	4 N.	2 E.	Neil C. Anderson 1	
Standard Oil Co.	35	4 N.	2 E.	Perry Anderson 1	
TULARE COUNTY:					
Trico Oil and Gas Co.	7	23 S.	23 E.	California-Western 1	
Trico Oil and Gas Co.	27	21 S.	25 E.	Callison 1	
VENTURA COUNTY:					
J. J. Munding	22	4 N.	22 W.	Jack Munding 1	Ojai
Pacific Western Oil Corp.	4	4 N.	18 W.	Temescal 6	Piru
Continental Oil Co.	15	3 N.	24 W.	Hobson 2	Rincon
General Petroleum Corp.	15	3 N.	24 W.	Padre 1	Rincon
Merchants Petroleum Co.	1	4 N.	20 W.	7	Sespe
Calco Petroleum Co.	17	3 N.	20 W.	4	South Mountain
George Duty and Associates	13	3 N.	21 W.	George Duty and Associates 1	South Mountain
Associated Oil Co.	22	3 N.	23 W.	Hartman 27	Ventura
Associated Oil Co.	23	3 N.	23 W.	V. L. & W. 25	Ventura
Associated Oil Co.	24	3 N.	23 W.	V. L. & W. 30	Ventura
Associated Oil Co.	27	3 N.	23 W.	Lloyd 28	Ventura
Associated Oil Co.	27	3 N.	23 W.	Lloyd 78	Ventura
General Petroleum Corp.	28	3 N.	23 W.	Barnard 17	Ventura
Shell Oil Co.	21	3 N.	23 W.	Edison 28	Ventura
Shell Oil Co.	28	3 N.	23 W.	Taylor 89	Ventura
Shell Oil Co.	30	3 N.	23 W.	Taylor 88	Ventura
The Texas Co.	6	2 N.	21 W.	Lloyd Butler 1	
Vaca Oil Exploration Co., Inc.	5	1 N.	21 W.	1	

SPECIAL ARTICLES

Detailed technical reports on special subjects, the result of research work or extended field investigations, will continue to be issued as separate bulletins by the Bureau, as has been the custom in the past.

Shorter and less elaborate technical papers and articles by members of the staff and others are published in each number of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

These special articles cover a wide range of subjects both of historical and current interest; descriptions of new processes, or metallurgical and industrial plants, new mineral occurrences, and interesting geological formations, as well as articles intended to supply practical and timely information on the problems of the prospector and miner, such as the text of new laws and official regulations and notices affecting the mineral industry.

BIENNIAL REPORT OF THE STATE MINERALOGIST

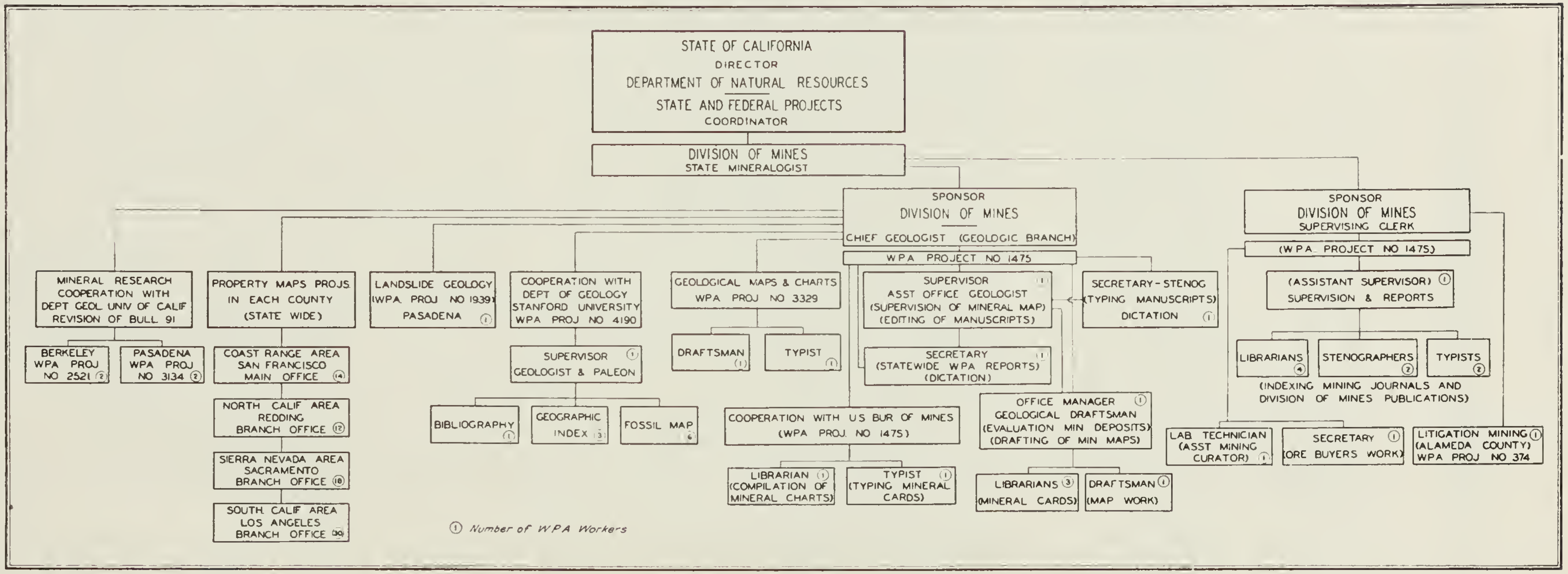
To Hon. George D. Nordenholt, Director,
Department of Natural Resources,
Sacramento, California.

Sir: Herein I have the honor to present the biennial report of the State Mineralogist as required by law (Stats. 1913, Chap. 679) for transmittal to His Excellency, Governor Frank F. Merriam, covering the work and activities of the Division of Mines of the Department of Natural Resources, for the period July 1, 1934, to June 30, 1936.

General Summary.

During the past two years, as in the preceding four, there has been continually increasing activity and interest in the mining industry in California, especially gold mining, in which this state still leads the nation. This greater activity and interest continues to tax the limited staff and funds of the Division of Mines in its demands upon the services and facilities we are endeavoring to maintain. However, in spite of limitations we have been able to hold the continuity and efficiency of the division's records and staff, and to render to the interested public and clientele invaluable service not obtainable elsewhere, which is daily promoting the economic development of California's valuable, diversified, mineral resources. That these results are concrete and economic, is evidenced by the volume of sales and the distribution of the division's publications (reports, maps, bulletins) and by the words and letters of commendation received from many individuals and operating companies.

Sales of the publications of the division have averaged nearly $400 per month for the biennial period under review, being a total of $9097.40. There is an active demand for maps (geologic, topographic, and of mining claims), as well as for the bulletins and other descriptive reports issued. To keep these revised and up-to-date it is necessary that our engineers make frequent field trips into the various mining districts for examinations and interviews with the operators, and for geological studies. The laboratory personnel continues to be kept busy with mineral samples from all over the state, on which the senders desire information, identification, and advice. There were 10,700 samples handled during the two-year period. Though a considerable percentage of the samples are tested for gold, the materials sent in run almost the entire gamut of mineral species, two or three hundred at least of which have commercial possibilities or probabilities. California is blessed with a wide diversity of them. The testing done in the laboratory of the Division of Mines is qualitative only, for the purposes of identification and advice as to commercial possibilities, as no quantitative analyses or assays are made which would compete with commercial firms in those lines.


STATE OF CALIFORNIA
DIRECTOR
DEPARTMENT OF NATURAL RESOURCES
STATE AND FEDERAL PROJECTS
COORDINATOR
DIVISION OF MINES
STATE MINERALOGIST
SPONSOR
DIVISION OF MINES
CHIEF GEOLOGIST (GEOLOGIC BRANCH)
WPA PROJECT NO 1475
SPONSOR
DIVISION OF MINES
SUPERVISING CLERK
(WPA PROJECT NO 1475)
MINERAL RESEARCH COOPERATION WITH DEPT GEOL UNIV OF CALIF REVISION OF BULL 91
BERKELEY WPA PROJ NO 2521 ②
PASADENA WPA PROJ NO 3134 ②
PROPERTY MAPS PROJS IN EACH COUNTY (STATE WIDE)
COAST RANGE AREA SAN FRANCISCO MAIN OFFICE ⑭
NORTH CALIF AREA REDDING BRANCH OFFICE ⑫
SIERRA NEVADA AREA SACRAMENTO BRANCH OFFICE ⑱
SOUTH CALIF AREA LOS ANGELES BRANCH OFFICE ㉚
LANDSLIDE GEOLOGY (WPA PROJ NO 1939) PASADENA ①
COOPERATION WITH DEPT OF GEOLOGY STANFORD UNIVERSITY WPA PROJ NO 4190
SUPERVISOR ① GEOLOGIST & PALEON
BIBLIOGRAPHY ①
GEOGRAPHIC INDEX ③
FOSSIL MAP ⑥
GEOLOGICAL MAPS & CHARTS WPA PROJ NO 3329
DRAFTSMAN ①
TYPIST ①
SUPERVISOR ① ASST OFFICE GEOLOGIST (SUPERVISION OF MINERAL MAP) (EDITING OF MANUSCRIPTS)
SECRETARY ① (STATEWIDE WPA REPORTS) (DICTATION)
SECRETARY-STENOG (TYPING MANUSCRIPTS) DICTATION ①
COOPERATION WITH US BUR OF MINES (WPA PROJ NO 1475)
LIBRARIAN ① (COMPILATION OF MINERAL CHARTS)
TYPIST ① (TYPING MINERAL CARDS)
OFFICE MANAGER ① GEOLOGICAL DRAFTSMAN (EVALUATION MIN DEPOSITS) (DRAFTING OF MIN MAPS)
LIBRARIANS ③ (MINERAL CARDS)
DRAFTSMAN ① (MAP WORK)
(ASSISTANT SUPERVISOR) ① SUPERVISION & REPORTS
LIBRARIANS ④
STENOGRAPHERS ②
TYPISTS ②
(INDEXING MINING JOURNALS AND DIVISION OF MINES PUBLICATIONS)
LAB TECHNICIAN (ASST MINING CURATOR) ①
SECRETARY ① (ORE BUYERS WORK)
LITIGATION MINING ① (ALAMEDA COUNTY) WPA PROJ NO 374
① Number of WPA Workers

Organization chart showing in graphic form the extent to which the Division of Mines is making use of W. P. A. funds. A total of 114 W. P. A. workers are shown to be employed.

As the number of persons panning and washing for gold in the streams and gulches of our hills and mountains, and requiring avenues through which to dispose of their pannings, has slacked off some during the past two years, the number of ore-buyer's licenses issued by the State Mineralogist has decreased somewhat, but still maintains a high level. For the calendar year 1932 there was a total of 108 such licenses; 178 in 1933; 243 in 1934 (of which 121 were limited to total purchases up to $1,000 annually; and 122 for totals above $1,000); 217 in 1935 (94 limited and 123 unlimited); and 197 to date in 1936 (86 limited, 111 unlimited). In addition to the above, 10 branches of the Bank of America buy gold under a single license issued to the parent corporation. For the two fiscal years under review, the revenue from fees for the above-noted licenses was $2,077 and $1,955.50 respectively, or a total of $4,030.50. In addition there came to the state treasury $5,672.53 for credit to the "ore-buyer's license fund" from the sale of seized, stolen bullion which escheated to the State, because the original ownership of it could not be established satisfactory to the courts.

The project which began in the spring and summer of 1934 through the State Emergency Relief Administration (S. E. R. A.) and through which the San Francisco office of the Division of Mines obtained clerical help in cataloguing, indexing, and arranging the library and museum files, has been continued and extended through the agency of the federal Works Progress Administration (W. P. A.). At this writing it includes a total of 112 workers (both men and women), and not only typists and stenographers, but librarians, draftsmen, geologists, laboratory assistants, a mining lawyer, photographer, and land-title record searchers. Much valuable work is being accomplished, also records and files of great value and usefulness to the division have been compiled. This is in part being done in the district offices of the division at Sacramento, Los Angeles, and Redding as well as in the San Francisco headquarters. Also mining claim records are being obtained in the offices of the county Recorders throughout the state and in the United States General Land Office branches at Sacramento and Los Angeles. The accompanying chart attached hereto shows the scope and relationship of these W. P. A. projects.

In both 1935 and 1936, prior to July 1st, Congress passed bills waiving the federal requirement for the annual assessment work on mining claims. The State Mineralogist kept mine owners advised as to the requirements and procedure through means of press bulletins, in which was included a suggested form for filing one's "intention to hold" claims under benefit of these acts.

Reference was made in our preceding biennial report to the fact that at the 1934 session of Congress, Representative Harry L. Englebright of California introduced and succeeded in having passed an amendment (approved June 19, 1934) to the Caminetti Act providing for a more equitable and feasible method for payment of dam construction costs for hydraulic-mining debris through the storage charges. This amendment provides that mines storing their debris behind any dams or other works erected by the commission shall pay a tax for each cubic yard mined as measured in the natural bank, equal to the total capital cost of the dam, reservoir and rights of way (not including interest), divided by the total capacity of the reservoir for the restraint of debris, and that revenue from the sale of this storage shall be set aside and credited to a fund to be used for repayment of any funds advanced by the Federal Government or other agencies for the construction of restraining works and settling reservoirs, and for maintenance.

Pursuant to a resolution adopted August 18, 1933, by the Committee on Rivers and Harbors of the House of Representatives, the Board of Engineers for Rivers and Harbors was requested to review the reports on Sacramento River on the subject of debris control, with particular reference to the construction of certain dams and the participation or the interest of the Federal Government in their construction. The job was delegated, in turn, to the California Debris Commission.

After working for approximately 1½ years, and the expenditure of $95,000, the Commission rendered its report under date of February 13, 1935, to the Board of Engineers for Rivers and Harbors, and while finding that dams at certain specified points were feasible, physically, drew certain conclusions therein from economic and federal-interest standpoints, which were considered by interested Californians to be not in accordance with the actual facts. Particular objection was raised to the statement of ''insufficient information available to accurately determine the gold content of the gravels.''

A hearing in protest of those conclusions was arranged for and held before the Board for Rivers and Harbors in Washington, on April 15, 1935. Besides Congressman Englebright and the representatives of a number of gravel-mine owners, the State Mineralogist of California, by direction of His Excellency, Governor Frank F. Merriam, appeared before the Board and presented both briefs and oral arguments. As a result of that hearing and their study of the reports and data relating thereto, the Board of Engineers for Rivers and Harbors, under date of May 23, 1935, rendered a report in which it reversed the conclusions of the California Debris Commission, and stated:

> "After careful consideration of all available data and all factors concerned, the Board concludes that construction of four storage developments essentially as planned by the California Debris Commission is economically justified and that revenue from the sale of debris storage rights will reimburse the United States for the funds advanced * * *
>
> "The Board recommends the construction, at an estimated cost of $6,945,000, of the four debris storage reservoirs in the Sacramento Basin (Upper Narrows, Dog Bar, North Fork, and Lower Ruck-a-Chucky) set forth in the plans of the California Debris Commission, with such modifications as may be approved by the Chief of Engineers, subject to the condition that work shall not be begun on any reservoir until the repayment of the capital cost thereof by the payment of taxes on material hydraulically mined from the natural bank in accordance with the provisions of Section 23 of the act to create the California Debris Commission and regulate hydraulic mining in the State of California, as amended by an act approved June 19, 1934, is assured to the satisfaction of the Secretary of War through guaranties of responsible individuals, companies and/or corporations that they will if the reservoir is constructed, hydraulically mine under license from the California Debris Commission, material in amounts aggregating the total capacity of the reservoir for the restraint of debris."

Following the presentation of the aforementioned report, there was included by amendment in the Senate, the item of $6,945,000 to the Rivers and Harbors Bill. The amendment was accepted by the Conference Committee and the House, and the bill was signed by President Roosevelt on Aug. 31, 1935. These four hydraulic-mining dams are thus given the status of an authorized federal project, with an authorization of the foregoing amount for their construction. At the 1936 session of Congress funds to begin construction were included in the appropriation bills. The actual building only awaits now the signing of guaranties on the part of the mine owners and operators for sufficient yardages to satisfy the California Debris Commission and the Chief of Engineers.

Each of the past two years, the Division of Mines has placed an exhibit of California's mineral resources at the State Fair. As on previous occasions this was made possible in certain features by the generous assistance of friends and mine operators. The secretary of the State Fair, Mr. Chas. Paine very kindly placed at our disposal a suitable safe, which we have equipped with electric lights for the display of gold specimens loaned by a number of mining companies. At Mr. Paine's request we assisted him in selecting judges for passing upon the merits of the mineral displays shown by the various counties in the main exhibit building.

During the calendar year 1934, there was reported commercial production of fifty-nine different mineral substances, exclusive of a segregation of the various stones grouped under 'gems', all of the fifty-eight counties of the state contributing to the total value which was $237,374,709. This was an increase of $30,885 651 over the total for 1933, which was $206,489,058; to which increase most of the important mineral substances contributed, but especially petroleum, gold, borates, cement, miscellaneous stone (crushed rock, sand, gravel), tungsten ore, diatomite, brick and hollow building tile. Decreases in value were shown by natural gas, copper, potash, limestone. In 1935 there was an increase in estimated total value to $256,938,000 for which mainly petroleum, gold, and natural gas were responsible, the only important product showing a decrease being cement.

Geologic Branch.

The remarkably long list of reports and maps classified and listed below will appear still more remarkable when it is remembered that the entire regular staff of the Geologic Branch consists of one person, Dr. Olaf P. Jenkins. This amount of work could not have been handled had it not been for the cooperation of many deeply interested professional geologists and institutions who have contributed help in order to make the work a success. Also much clerical and some technical assistance has been supplied by the federal Public Works Administration.

It must be understood that no geological report is ever submitted by the Geologic Branch for publication until it is first read and criticized by one or more geologists who have special knowledge of the field covered. The report is often first presented before a professional society for discussion. The field of work is checked over by the Chief Geologist (when field expenses permit) during the progress of the work as well as after it is completed. Finally the report is edited by him with considerable care. Special emphasis is laid on the relation of geology to the economic development of the region under discussion.

It would facilitate matters greatly if the chief geologist could be supplied with one technical assistant, one geological draftsman, and one stenographer, as part of the regular civil service staff. The help supplied by W.P.A. will doubtless not be continued beyond a few months more, and if so the continuity of the work will be greatly impaired unless this office assistance is provided.

Since the chief geologist has made a special study of the production of fine lithographic maps, and since he now has a large amount of accurate information to put on the state map, it would be an economy to employ a good geological draftsman in order to prepare for publication state geologic and economic mineral maps which are in constant demand by the public. The rapid and continuous sale of those maps already issued of specific areas certainly justifies the preparation and publication of these useful maps which will cover the entire state.

In order to direct and supervise the field work of field geologists who volunteer to carry on investigations (largely graduate students working on their PhD. theses) it is necessary for the chief geologist to be supplied with adequate field expenses. Besides, he should be permitted to make investigations in the field himself so as to help in the completion and coordination of the state geologic map. There should be, in addition, also a limited fund for payment of field expenses for certain worthy investigators who are willing to contribute their time on worthwhile projects such as the mapping of important areas now blank spots on the state geologic map. In no other way will it be possible to complete certain large sections of the State map in the northwest coastal region, in the Klamath Mountains, in the southern Sierra Nevada, and in the southeastern desert mountain section.

Publications During This Biennial Period Based Upon Field Investigations

(Work in large part contributed)

1. Geology and mineral deposits of the Julian District, San Diego County, California —by Dr. Maurice Donnelly (Cal. Tech.).
2. Geology and mineral deposits of the Elizabeth Lake quadrangle, California—by Dr. Edward C. Simpson (U.C.).
3. Geologic features of the dry placers of the northern Mojave Desert—by Prof Carlton D. Hulin (U.C.).
4. Geological investigation of the clays of Riverside and Orange Counties, Southern California—by Dr. J. Clark Sutherland (U.C.).
5. A geologic section across the southern Peninsular Range of California—by Prof. W. J. Miller (U.C.L.A.).
6. Geology of a portion of the Perris Block, Southern California—by Paul H. Dudley (Cons. Geol.).
7. Borax Lake, California—by M. Vonsen and Dr. G. D. Hanna (Cal. Acad. Sciences).
8. New technique applicable to the study of placers—by Olaf P. Jenkins (Chief Geologist).

Manuscripts on Hand

(*The Result of Field Investigations*)

(In large part contributions)

1. Geology of the Newberry and Ord Mountains—by Dion Gardner (U.C.).
2. Geologly of San Nicolas and Santa Barbara Islands—by Luis E. Kemnitzer (Cal. Tech.).
3. Geologic section of the Nopah Range, Inyo County—by John C. Hazzard (U.C.L.A.).
4. Geology and mining of the borate deposits of the Kramer District, San Bernardino County—by Hoyt S. Gale (Cons. Geol.).
5. Mechanics of landslides—by William Cogen (Cal. Tech.).

Completed or Nearly Completed Field Investigations

(Manuscripts not yet complete; for the most part the work is a contribution)

1. Geological investigation of the graphite deposits of Los Angeles County—by Burt Beverly, Jr. (Cornell).
2. Geology and mineral deposits of the Amboy quadrangle, San Bernardino County—by John C. Hazzard (U.C.L.A.).
3. Geology and mineral deposits of the Duncan Mills and Sebastopol quadrangles, Marin and Sonoma Counties—by F. A. Johnson (U.C.).
4. Geologic investigation of sand deposits of California—by Dr. E. Wayne Galliher (Stanford).
5. Geology and ore deposits of the Bodie mining district, Mono County—by Francis Frederick (U.C.).
6. Geology of the eastern front of the Sierra Nevada, Mono County—by Dr. Evans B. Mayo (Cornell).
7. Geology of the Kaweah quadrangle, Tulare County—by Cordell Durrell (U.C.).
8. Geology of the Shasta copper district—by Dr. G. F. Seager (Yale).
9. Geology and mineral deposits of the Lucia quadrangle, Monterey County—by Dr. Parry Reiche (U.C.).
10. Tertiary geology of a part of northern California—by R. Dana Russell (U.C.).

Reports of State-wide Scope

(Now in process of compilation)

1. Bibliography of the geology and mineral resources of California for the years 1931–1936, inclusive—by Prof. Solon Shedd (Stanford) with W. P. A. help. (A continuation of, or supplemental to, our Bulletin 104).
2. Minerals of California (revision of Bulletin 91)—by Prof. Adolf Pabst (U.C.) with W. P. A. help.
3. Geographic card index of California—by Olaf P. Jenkins (Chief Geologist) with W. P. A. help.
4. Handbook of the geology of California to accompany the state geologic map—by Olaf P. Jenkins (Chief Geologist), with W. P. A. help and outside technical cooperation. The plan is to issue a 4-volume text: I. Surface features. II. Mineral resources (not including oil and gas). III. Historical geology and the oil and gas resources. IV. Areal and structural geology.
5. State geologic map—by Olaf P. Jenkins (Chief Geologist). It is planned to issue a series of four accurate, authoritative, practical, and very useful maps covering the entire state of California, showing the following features: culture, streams, roads, topography, mineral resources, oil and gas fields, fossil-collecting localities, and areal and structural geology. Scale of map 1:500,000, about eight miles to the inch. Each state map to be printed in six sheets, 28 x 42 in., making an assembled wall map 7 ft. x 7 ft. Map showing geological formations to undergo three preliminary issues before it is printed in full standard colors. Preparation of maps well under way, each to be printed as soon as completed—in the following manner:
    - I. General topographic and first preliminary geologic map of California.
    - II. Economic mineral localities and second preliminary geologic map of California.
    - III. Oil and gas fields, fossil-collecting localities, and third preliminary geologic map of California.
    - IV. Areal geologic map of California, in full standard colors.

    Note: There is a very great demand for maps of this character from every imaginable source. In the process of assembling the data for these maps a large fund of accurate data concerning the relationship of regional geology to the occurrence and distribution of mineral deposits has been accumulated and it is planned that this information will be incorporated in the accompanying four-volume text.

Publications.

Publications issued July 1, 1934, to June 30, 1936:

October chapter of State Mineralogist's Report XXX, 1934. Among the more important subjects included are:

Current Mining Developments in Northern California;
Current Mining Activity in Southern California;
Geology and Mineral Deposits of the Julian District, San Diego County;
Geology and Mineral Deposits of the Elizabeth Lake Quadrangle;
Geologic Features of the Dry Placers of the Northern Mojave Desert.

Special articles on:

Government can not challenge right to mining claims for failure to perform annual assessment work within Withdrawn Areas;
Biennial Report of the State Mineralogist;
Death Valley National Monument Now Open to Mining.

State Mineralogist's Report XXXI, 1935. Among the more important subjects included are:

Review of Gold Mining in East-Central California, 1934;
Current Mining Activities in the San Francisco District, with Special Reference to Gold;
Geological Investigation of the Clays of Riverside and Orange Counties;
A Geologic Section Across the Southern Peninsular Range of California;
New Technique Applied to the Study of Placers;
Mines and Mineral Resources of Siskiyou County;
Mines and Mineral Resources of San Luis Obispo County;
Mineral Resources of Portions of Monterey and Kings Counties;
Mining Activity at Soledad Mountain and Middle Buttes—Mojave Mining District, Kern County;
Geology of a Portion of the Perris Block, Southern California;
Mineral Resources of a Portion of the Perris Block, Riverside, California.

Special articles on:

Information regarding Mining Loans by the Reconstruction Finance Corporation;
Grubstake Permits;
Dams for Hydraulic Mining Debris;
Leasing System as Applied to Metal Mining;
Mine Financing in California;
New Laws make Radical Change in Mining Rights;
Sources of Gold Produced in California, 1848 to 1934.

January and April, 1936, chapters of State Mineralogist's Report XXXII. Among the more important subjects included are:

Gold Mines of Placer County;
Borax Lake, California,

and special articles on:

Geology, Mining and Processing of Diatomite at Lompoc, Santa Barbara County;
Essentials in Developing and Financing a Prospect into a Mine;
The Gold-Bearing Veins of Meadow Lake District, Nevada County.

Bulletin 106. (Third Edition, revised and enlarged, August 1935; Fourth Edition, enlarged, March 1936.) Manner of Locating and Holding Mineral Claims in California, by A. H. Ricketts, 25 pages and 26 pages, respectively. Gives essential information, laws, and forms for locating mining claims and for maintaining title thereto.

Bulletin 108. Mother Lode Gold Belt of California, by Clarence A. Logan, 240 pages, 33 illustrations, 10 maps. Describes mines, their geology, development, and equipment in this gold belt which extends through the five counties of El Dorado, Amador, Calaveras, Tuolumne, and Mariposa.

Bulletin 110. California Mineral Production and Directory of Mineral Producers for 1933, by Henry H. Symons, 214 pages, 21 illustrations. Gives detailed figures of commercial production of all mineral substances in California for the calendar year 1933.

Bulletin 111. California Mineral Production and Directory of Mineral Producers for 1934, by Henry H. Symons, 334 pages, 13 illustrations. Gives detailed figures of California's mineral production for the calendar year 1934, and also tables of the total recorded production of all minerals for each of the 58 counties to the end of 1934.

Conclusion.

It has been said on previous occasions, and it cannot be emphasized too strongly that the functions and the work of the Division of Mines are developmental, bringing capital into California, building up her natural resources and manufacturing industries and pay rolls, and providing active taxable properties. In order to keep abreast of commercial developments and activities in all mineral lines and to maintain a high efficiency in the Division's work, it is especially important that field contacts and studies be frequently made, and that the results be published promptly in the form of bulletins, reports and maps for public distribution and sale. It is readily seen that to accomplish these results to the full benefit to the State adequate funds must be appropriated for the support of the Division of Mines, particularly for field expenses and for printing.

Respectfully submitted.

WALTER W. BRADLEY,
State Mineralogist.

San Francisco, September 25, 1936.

PROPERTIES AND INDUSTRIAL APPLICATIONS OF OPALINE SILICA

By JOHN T. THORNDYKE.[a]

The position of opaline silica, or silica hydroxide, is not definite in the classification of minerals. It is primarily a silica gel—that is, it possesses no crystalline form, but occurs as massive, stalactite or globular banded masses. It is an amorphous mineral, apparently composed of silica and variable amounts of water, ranging from 2% to as much as 12%.

Opaline silica occurs in several forms, among which is included precious, or fire opal, familiar to everyone. The varieties considered in this article, upon which tests were made and conclusions formed, are girasol, common opal, cachalong, hyalite, siliceous sinter and geyserite. Tripolite and infusorial earth have been omitted from the discussion because of the considerable variation in their chemical analyses, which prevented the accumulation of any consistent set of results. While representative samples of other opaline silicas, taken from widely-separated deposits, also showed some variation, that variation was only in the silica-water ratio. Tests proved conclusively that those differences had no control over the bleaching action of the material on oils, either edible or mineral.

Opaline silica has a hardness of 5.5–6.5, and a density or specific gravity of 2.1. It is amorphous; and has a wide range of colors. It generally occurs in the vicinity of hot springs as a hydro-thermal product, though cold water deposits are also thought to exist.

In this paper there will be no attempt made to differentiate between individual members of the opaline silica group. All of the results obtained, and all of the tests made are those applicable to all members of the group, even though the samples were secured from widely separated deposits.

During tests made upon the material it was found that opaline has a peculiar surface affinity or attraction for acidic compounds, waxes, and coloring matter, and, in addition, is sufficiently porous to act as an ideal filter and polishing medium for finished gasoline, and as a de-hydrator for gasses. Tripoli, infusorial earth, and similar materials consisting chiefly of amorphous silica today have a large and varied use in the petroleum refineries of the United States; opaline silica, though more efficient, has been passed by simply because of the lack of knowledge and definite information regarding its actions and capabilities.

Tests made on old samples of "Acid treated cocoanut, cottonseed and peanut oils" showed that the opaline silica possessed a definite bleaching power equal in every instance, and in many surpassing, standard English fullers earth. These tests were made upon oil samples that were known to be aged, and to contain numerous inert products.

Tests made on two of the most difficult edible oils, sardine and shark, were extremely satisfactory, inasmuch as bleaching was accomplished, and the odor appreciably removed. As a consequence, these two products could be used in some fields in direct competition with vegetable oils.

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[a] Mining Engineer, Los Angeles, California.

By passing the oil to be treated through a column of opaline silica of the proper particle size, the following definite results, as specifically applied to edible oils, were obtained:

Bleaching and clarification
Removal of the major portion of the "free fatty acids"
Removal of all foreign matter and inerts
Removal of odors and objectionable features of fish oils
Removal of waxes
Bleaching and removal of inerts in waxes (beeswax)

The process now in use for the treatment of edible oils is as follows: Oils are brought to a certain temperature and English fullers earth or other clays are added, the entire charge or batch well agitated, and then passed through large filter presses where the fullers earth or other clays are for the most part removed. Heating and agitation is resorted to a second time, and a second pass is made through the filter presses. By this time the product is bleached and filtered, but it still contains small amounts of inert colloidal clay or earthy products, and practically all free fatty acids. To remove the latter, the product is treated with caustic soda; next it is washed with water, then centrifuged to remove the water and caustic soda. At this stage the material is considered ready for fabrication into many products for human use, despite the fact that a small percentage of caustic soda and inert colloidal silica or clay still remains in the edible oil.

Compare the above procedure with that to be used where opaline silica takes the place of the usual clays: It is simply necessary to install columns to be filled with opaline silica of the proper particle size. A continuous process can be used wherein there would be no filter presses, nor would the injurious caustic soda or water be needed. Since the opaline silica is not a soluble product, no inert colloidal matter can be carried through into the finished product. Clays and fullers earth retain a considerable percentage of the oils treated as cake retention or absorption. The amount may range from as much as 12% to 35%. This oil is lost unless a reclaiming process is installed. Fullers earth and other clays can be used but once as bleaching media, whereas opaline silica can be used until its particle surface becomes inactive or saturated with foreign substances; even then it is only necessary to shut off the flow of oil, by-pass the saturated column, reverse and wash the opaline with hot water or steam, allow the column to drain, and then place it in the circuit of operation again. These facts have been demonstrated by actual tests.

It is known that hydrated silica ,which is precipitated from solutions of silicates, and which is commonly known as 'silica gel,' is an active absorbent; the natural hydrated silica, or opaline silica, possesses the properties of such gels to a great extent, and likewise is an active absorbent.

Absorbents used in the oil industry are: fullers earth, special clays, silica-gel and prepared vegetable chars, diatomaceous earth, tripoli, and acid-treated products. Of these, fullers earth and diatomaceous earth have the broadest application, particularly in percolation methods. When these products and opaline silica were compared with regard to rate of flow or through-put and cake retention, in every instance opaline silica demonstrated the highest efficiency of operation.

Practically all of the fullers earth, which is used in tremendous amounts by West Coast refineries, is shipped from Florida, where all deposits of commercial size are owned outright by large companies. Opaline silica, a California product, will be available at one-half the cost if it becomes necessary to meet competition.

Silica-gel is a finely-divided preparation of silica, the minute particles of which are extremely porous; it is produced by the Davidson Chemical Co. It is extensively used in gas absorption problems. Some development work has been done with petroleum products, the results of which have beeen highly satisfactory, but the cost has so far been in the neighborhood of $1.50 per pound. Now, however, the benefits of silica-gel can be made available at a reasonable cost by the manufacture of the gel from opaline silica. Should it be desirable to use crude opaline silica, the following comparison, based on results obtained plus a supposition, is of interest: Granting that the efficiency of silica-gel is 100% on a certain crude product, its cost is $1.50 per pound, both for installation and replacement; then opaline silica, on a supposition of 20% efficiency, is certainly attractive to the petroleum industry at an installation or replacement cost of even $100 per ton. In fact, it is entirely possible to treat opaline silica and supply silica-gel at a cost of $100 per ton, as can be readily understood from the tests recorded in the following paragraphs. It must be borne in mind that opaline silica's peculiar affinity for acids and waxes applies particularly to the petroleum industry inasmuch as practically all petroleum products are treated with sulphuric acid and caustic soda, which, along with water, must be removed.

Tests on sugar solutions, waxes, cleaners solvent, alcohol, wines, and whiskeys for the removal of inert or foreign substances and odors were made with fullers earth, diatomaceous earth special products, and opaline silica. In every instance the efficiency of the opaline silica equalled, and in many cases it surpassed that of the other materials. Tests made on Signal Hill, California, water, which has a yellowish color and an objectionable sulphurous odor, resulted in its being bleached to an appreciable degree, and in the removal of most of the sulphur.

Installation of opaline silica was made in a plant of the Pan-American Oil Co. in Long Beach, and kerosene stock was brought to the required color without injuring the 'bloom' in any way.

Tests made on waste waters from several large laundries demonstrated that it is possible to reclaim all water, soap, and the greater portion of the chemicals used, at a fraction of the present cost; but the system was rejected because of the possibilities of adverse advertising on the part of competitors. Small installations and tests showed a marked lowering of the bacterial content of water passed through an opaline silica filtering system in the pool of the late Mr. Doheny at Beverly Hills, California. Domestic filters made from opaline silica, since that medium is not soluble in water or weak acids, really filtered the water and added nothing. Other filters now in use in many cases contain elements markedly soluble in water.

Opaline silica ground to minus 200-mesh was submitted to numerous foundry supply concerns, and all reported it entirely satisfactory for foundry facing and core-wash uses.

Tests were also made upon the methods of treating opaline silica for use exclusively in mineral oil refining. The silica was ground and treated with a fairly strong solution of caustic soda at boiling temperature, and some of the silica converted to a sodium silicate. The solution was then diluted somewhat and treated with sulphuric acid. This solution formed a gel, which was broken up and washed by decantation, then dried and pulverized to 200-mesh. Samples of opaline from many different deposits were treated with 10%, 20%, 40% and 80% caustic soda, depending upon the weight of opaline treated. These samples were boiled for 10 minutes, diluted with 100 cc. of water, and neutralized with 10% sulphuric acid, washed till free from sulphates, and dried in an oven. This treated product tested on 100 cc. of S. A. E. 20 Raffinate from the Union Oil Co. with two grams of the dried material, screened to 150 mesh, at 356° F., showed that 20% caustic made a better material than did 10%, but that 40% and 80% caustic made a material very little better than 20%.

Some miscellaneous tests made on 10%, 15%, and 20% treats are listed here:

100 gr. Opaline 10 gr. Caustic 150 cc. Water	Boil 30 minutes. Dilute to 450 cc. Neutralize. 2 gr./100 cc. Raffinate 4 9/16 color
100 gr. Opaline 10 gr. Caustic 250 cc. Water	Boil one hour. Neutralize 2 gr./100 cc. Raffinate 4¼ color
100 gr. Opaline 20 gr. Caustic 750 cc. Water	Boil two hours down to 150 cc. Dilute to 750 cc. and neutralize 2 gr./100 cc. Raffinate 4 color
100 gr. Opaline 10 gr. Caustic 300 cc. Water	Boil one hour. 2 gr./100 cc. Raffinate 4½ color
100 gr. Opaline 15 gr. Caustic 300 cc. Water	Boil ½ hour down to 175 cc. Dilute to 600 cc. and neutralize 2 gr./100 cc. Raffinate 4⅛ color
100 gr. Opaline 20 gr. Caustic 600 cc. Water	Boil one hour 2 gr./100 cc. Raffinate 4¼ color

Experiments are under way at the present time to determine whether smaller amounts of caustic can be used by treating under pressure.

Two sets of experiments were made to determine the effect of the degree of neutralization of the treated opaline upon the color produced by the dried and screened material.

The first set consisted of treating ground opaline with caustic and soda ash, and then adding ⅓, ⅔ and the full amount of 10% sulphuric acid required to neutralize the base present, to separate portions of the caustic-treated opaline solution. The three resulting gels were then washed four times, dried, and ground to 200-mesh.

The following table shows the results of treating 100 cc. of Union Oil S. A. E. 20 Raffinate with 2 grams of 200-mesh material:

Degree of neutralizing 1/3	N.P.A. Color 5 1/2
Degree of neutralizing 2/3	4 7/8
complete	4 1/2

The second set of experiments on opaline treated with 20% caustic soda, finished by the usual procedure, after acid treatment, gave the following results:

Degree of neutralizing 3/4	N.P.A. Color 4 1/2
complete	3 7/8

Qualitative experiments indicated that when excess acid was added, there was probably a slight loss of color, and certainly a partial re-solution of gel.

Experiments are being made testing the possibilities of the use of opaline silica in the dental profession for the manufacture of porcelains.

Thus it is seen that opaline silica, a supposedly valueless nonmetallic mineral, actually offers many opportunities for commercial utilization. The State of California has large deposits available.

ADMINISTRATIVE

Walter W. Bradley, State Mineralogist.

Personnel

There have been no changes of personnel in the Division of Mines to be noted the past three months.

New Publications

California Journal of Mines and Geology, April, 1936, being Chapter II of State Mineralogist's Report XXXII. This chapter contains: 'Geology, Mining and Processing of Diatomite at Lompoc, Santa Barbara Co.;' 'Essentials in Developing and Financing a Prospect Into a Mine;' 'Gold-bearing Veins of Meadow Lake District, Nevada Co.;' 'California Semi-precious Gem Stones.'

Commercial Mineral Notes (Nos. 160–162 inc.), August-October, respectively. These 'Notes' contain the lists of 'mineral deposits wanted,' and 'mineral deposits for sale,' issued in the form of a mimeographed sheet monthly. It is mailed free to those on the mailing list for California Journal of Mines and Geology, and to others on payment of 15 cents postage paid in advance for the year. As an evidence of the interest in mines and mineral resources now showing considerable activity, this mimeographed 'sheet' has had to be expanded to two and three pages in recent months.

Mail and Files

The Division of Mines maintains, in addition to its correspondence files and the library, a mine file which includes original reports on the various mines and mineral properties of all kinds in California.

During each quarterly period there are several thousand letters received and answered at the San Francisco office alone, covering almost every phase of prospecting, mining and developing mineral deposits, reduction problems, marketing of refined products and mining law. In addition to this, hundreds of oral questions are answered daily, both at the main office and the district offices, for the many inquirers who come in for personal interviews and to consult the files and library.

MINERALS AND STATISTICS

Statistics, Museum, Laboratory

Henry H. Symons, Statistician and Curator

We have complete 1935 data on three groups of mineral products—structural, industrial, and saline—but inasmuch as the Division of Mines depends on outside sources for the final figures on petroleum, gold, and silver, and these have not yet been made available, the tabulation of statistics is not complete.

A detailed annual report on the mineral production of California for 1935 will be available as Bulletin 112 of the State Division of Mines.

STRUCTURAL MATERIALS

As indicated by this subdivision heading, the mineral substances herein considered are those more or less directly used in building and structural work. California is independent, so far as these are concerned, and almost any reasonable construction can be made with materials produced in the State. Chromite, which was previously listed under structural material in the statistical reports of the State Division of Mines, is now transferred to the metals group, thus coinciding with the practice of the United States Bureau of Mines.

This branch of the mineral industry for 1935 was valued at $18,794,298, as compared with a total of $22,837,446 for the year 1934. All the materials grouped under this classification showed an increase in 1935, with the exception of cement, miscellaneous stone, marble and slate.

In 1934 all counties, with the exception of Sutter, contributed to this structural total. There is not a county in the fifty-eight counties of the state which is not capable of producing at least one of the materials under the classification and in 1926 every county contributed one or more substances to the group.

The following summary shows the value of the structural materials produced in California during the years 1934–1935, with increases or decreases in each instance:

Substance	1934		1935		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Brick and hollow building tile		$1,644,661		$1,855,343	$201,682+
Cement	8,936,085 bbls.	12,445,616	8,086,292 bbls.	10,120,721	2,315,895—
Granite		249,083		339,917	90,834+
Lime	32,500 tons	309,765	59,731 tons	573,212	263,447+
Marble[1]		10,759		9,884	875—
Sandstone		14,245		9,268	4,977—
Slate		24,245		40,912	16,667+
Stone, miscellaneous		7,131,330		5,571,041	1,560,289—
Unapportioned		[2]249,125		[3]317,148	68,023+
Total values		$22,078,829		$18,837,446	
Net decrease					$3,241,383

[1] Includes onyx and travertine.
[2] Includes bituminous rock, magnesite, paving blocks, tube-mill pebbles.
[3] Includes bituminous rock, magnesite, tube-mill pebbles.

INDUSTRIAL MATERIALS

The following mineral substances have been arbitrarily arranged under the general heading of 'Industrial Materials,' as distinguished from those which have a clearly-defined classification, such as metals, salines, structural materials, etc.

These materials, many of which are mineral earths, are, with four or five exceptions, as yet produced on a comparatively small scale. The possibilities of development along several of these lines are large, and with increasing transportation and other facilities, together with steadily growing demands, the future for this branch of the mineral industry in California is promising. There is scarcely a county in the State but might contribute to the output.

Up to within the last few years, at least, production has been in the majority of instances dependent upon more or less of a strictly local market, and the annual tables show the results of such a condition, not only in the widely-varying amounts of a certain material produced from year to year, but in widely-varying prices of the same material.

The more important of these minerals thus far exploited, so far as shown by value of the output, are barytes, bentonite (fuller's earth), pottery clay, diatomite, dolomite, gypsum, limestone, mineral water, pumice and volcanic ash, pyrite, silica, and soapstone and talc.

This group, as a whole, showed an increase in total value from $4,276,566 in 1934 to $4,618,588 in 1935.

The following table gives the comparative figures for the amounts and value of industrial minerals produced in California during the years 1934 and 1935.

Substance	1934		1935		Increase + Decrease — Value
	Amount	Value	Amount	Value	
Barytes	21,769 tons	$125,514	22,979 tons	$133,810	$8,296+
Bentonite (Fuller's Earth)	6,168 tons	69,325	10,204 tons	68,372	953—
Clay (pottery)	190,510 tons	245,900	240,014 tons	377,969	132,069+
Gems		2.456		948	1,508—
Gypsum	58,149 tons	113,606	70,833 tons	151,807	38,201+
Limestone	198,057 tons	461,139	227,214 tons	496,054	34,915+
Mineral water	19,882,436 gals.	1,071,197	16,659,254 gals.	940,333	130,864—
Pumice and volcanic ash	9,951 tons	54,248	14,890 tons	87,055	32,807+
Silica (glass, sand and quartz)	70,432 tons	296,643	70,835 tons	297,272	629+
Soapstone and talc	13,920 tons	158,606	17,332 tons	170,830	12,224+
Sulphur	4,412 tons	67.656	*	*	*—
Unapportioned		[1]1,610,276		[2]1,894,138	283,862+
Total values		$4,276,566		$4,618,588	
Net increase					$342,022

* Included under 'Unapportioned.'

[1] Includes asbestos, carbon dioxide, diatomite, dolomite, feldspar, fluospar, pyrite, sillimanite-andalusite-cyanite group, wollastonite.

[2] Includes carbon dioxide, diatomite, dolomite, feldspar, graphite, mica, mineral paint, pyrite, sillimanite-andalusite-cyanite group, sulphur.

SALINES

Under this heading are included borax, common salt, soda, potash, and other alkaline salts. The first two have been produced in a number of localities in California, more or less regularly since the early sixties. Except for a single year's absence, soda has had a continuous production since 1894. Potash, magnesium chloride and sulphate, and calcium chloride have been added to the commercial list in recent years, joined in 1926 by bromide, and in 1931 by iodine. The nitrates are still prospective.

Our main resources of salines are the lake beds of the desert regions of Imperial, Inyo, Kern, Los Angeles, San Bernardino, and San Luis Obispo counties, and the waters of the Pacific Ocean.

The total value of this group showed a decrease from $10,413,019 in 1934 to $9,700,802 in 1935. The following table gives details for the years 1934 and 1935:

Substance	1934		1935		Increase+ Decrease— Value
	Amount	Value	Amount	Value	
Borates	240,696 tons	$5,524,262	280,249 tons	$4,602,064	$922,198—
Iodine	355,279 lbs.	423,016	*	*	*—
Magnesium salts	2,325 tons	194,642	2,795 tons	235,531	40,889+
Salt	332,194 tons	1,222,810	365,711 tons	1,230,480	7,670+
Soda	99,380 tons	1,219,561	125,504 tons	1,341,045	121,484+
Unapportioned		[1]1,828,728		[2]2,291,682	462,954+
Total values		$10,413,019		$9,700,802	
Net decrease					$712,217

* Included under 'Unapportioned.'

[1] Includes bromine, calcium chloride and potash.

[2] Includes bromine, calcium chloride, iodine and potash.

MUSEUM

The Museum of the State Division of Mines possesses an exceptionally fine collection of rocks and minerals of both economic and academic value. It ranks among the first five of such collections in North America and contains not only specimens of most of the known minerals found in California, but much valuable and interesting material from other states and foreign countries as well.

The exhibit is daily visited by engineers, students, business men, and prospectors as well as tourists and mere sightseers. Besides its practical use in the economic development of California's mineral resources, the collection is a most valuable educational asset to the state and to San Francisco.

Mineral specimens suitable for exhibit purposes are solicited, and their donation will be appreciated by the State Division of Mines as well as by those who utilize the facilities of the collection.

Among the specimens received recently and catalogued for the Museum are the following:

20693 CINNABAR and native MERCURY. From: Great Northern Quicksilver Mine, on Empire Creek, 25 miles northwest of Yreka, Siskiyou County, California. Donor: Humphrey Estate, Inc. August 5, 1936.

20694 GOLD ORE. From: Gilbert Mine, Los Burros Dist., Monterey County, California. Donor: Philo Fritz. August 17, 1936.

20695 GOLD ORE. From the Angel Mine, near Forbestown, Butte County, California. Donor: Thos. E. Kinny. August 17, 1936.

20696 Native GOLD in Quartz. Boulder found in cut during road construction, Plumas County, California. Donor: U. S. Forest Service. August 17, 1936.

20697 Native COPPER. From: Northern Michigan. Loaned by E. J. Toepfer. September 22, 1936.

20698 TIN. (Metal.) The peculiar shape here is the building up of drops from a leak in the furnace. Donor: H. C. Austin. September 22, 1936.

20699 ONYX. A banded form of Chalcedony. From: Near the Manhattan Mine, Knoxville, Napa County, California. Donor: W. A. Lohse. September 22, 1936.

20700 JASPER. From: Near Morgan Hill, Santa Clara County, California. Donor: Wilfred C. Eyles. September 22, 1936.

20701–A Crude Dry Mineral Paint Material.

20701–B Finished Dry Mineral Paint Material. Mined near Auburn, California. Donor: Synthetic Iron Color Co. September 22, 1936.

20702 Mica LAMPROPHYRE from a dike. From: Commonwealth Group on Davis River, southeastern Alaska. Donor: S. A. Tibbetts. September 14, 1936.

20703 GOLDEN CALCITE Crystals and Drusy Marcasite on Sphalerite. From: Commerce, Oklahoma. Exchange. September 23, 1936.

20704 GOLDEN CALCITE Crystals on wall rock. From: Commerce, Oklahoma. Exchange. September 23, 1936.

20705 MIAGYRITE, Sulphur of Antimony and Silver. From: The Kelly Mine, Randsburg, San Bernardino County, California. Exchange. September 23, 1936.

20706 SULPHUR—85% pure. From: The property of the Leviathan Sulphur Company in Alpine County, California. September 21, 1936.

20707 OPALIZED WOOD. From: Nevada County, California. Transferred from State Mineral Cabinet, Sacramento. September 21, 1936.

20708 FLUORITE (Fluorspar). From: Hoerner Claims, 20 miles southeast of Amboy, San Bernardino County, California. September 21, 1936.

20709 BLUE CHALCEDONY GEODE. From: Lead Pipe Springs, San Bernardino County, California. Donor: W. C. Eyles. September 24, 1936.

20710 VOLCANIC ASH. From: Gray Eagle Mine, Creston, San Luis Obispo County, California. Donor: M. L. Francis. September 25, 1936.

20711 NICKELIFEROUS PYRRHOTITE. From: Friday Mine, Julian, San Diego County, California. Donor: Allen Nicol. September 25, 1936.

20712 HOWLITE ($H_5Ca_2B_4SiO_{11}$) Hydrous Silico-borate of calcium. From: Lang, Los Angeles County, California. Donor: Allen Nicol. September 25, 1936.

20713 ASBOLITE (oxides of cobalt and manganese). From: Near Valley Springs, Calaveras County, California. Donor: E. W. Hayden. October 1, 1936.

20714 HANKSITE Crystal Cluster. From a deep well, Searles Lake, San Bernardino County, California. Exchange—John Melhase. October 9, 1936.

20715 ARCANITE $(K, Na)_2 SO_4$. An artificial Potassium Sulphide. From: Noble Electric Steel Company, Heroult, Shasta County, California. October 7, 1936.

20716 ANDRADITE GARNET, colored with chrome. From: Yerington, Nevada. Donor: Wilfred C. Eyles. October 9, 1936.

20717 LUDWIGITE, Magnesium iron borate ($3MgO.B_2O_3.FeOFe_2O_3.$) From: Salt Lake County, Utah. Donor: Wilfred C. Eyles. October 9, 1936.

20718 GRAPHIC GRANITE. From: Mesa Grade, San Diego County, California. Donor: Allen Nicol. October 15, 1936.

20719 ELLSWORTHITE, Titanoniobate of U,Ca and Fe. From: Hybla, Ontario, Canada. Donor: Wilfred C. Eyles. October 16, 1936.

20720 SCHEELITE Crystals in QUARTZ. From: Zinnwald, Bohemia. Donor: Wilfred C. Eyles. October 19, 1936.

20721 SCHEELITE Crystal ($CaWO_4$) Calcium Tungstate. From: Seoul, Korea. Donor: Herbert Salinger. October 21, 1936.

20722 HUBNERITE ($MnWO_4$) Manganese Tungstate. From: Las Guay Mine, Puma County, Arizona. Donor: Herbert Salinger. October 21, 1936.

20723 GOLD ORE, a product of secondary enrichment by the oxidation of sulphide minerals. From: The Recovery Mine, Chidago Mining District, Mono County, California. Donors: W. F. Murray and Walter Benge. October 26, 1936.

LABORATORY

FRANK SANBORN, Mineral Technologist

The laboratory of the Division of Mines is maintained for the purpose of identifying minerals and making qualitative analyses of rocks. These determinations and analyses are made without cost to those who seek the services of this state department. Ordinarily, a small sample weighing not over half a pound, in the lump form if possible, should be submitted with a letter stating what particular tests are desired, if there is a special reason for sending the material. Not more than three samples should be sent at one time, nor is it necessary to send more than one. Information regarding the size of the deposit and its proximity to rail transportation is useful in determining the possible value of a mineral body.

When requested, assistance in finding a market for a mineral will be given. When such help is desired, a small representative sample of the material for which a market is sought should accompany the request. The division is often able to send a very small sample of a particular mineral for comparative purposes to any earnest prospector. Very small pieces of certain silicates, such as andalusite, have been supplied to those desiring them.

Several thousand determinations are made annually by the Division of Mines, and prospecting and exploitation of the state's mineral wealth increases as the state becomes more thickly populated. Each year new occurrences of some mineral in the state are reported and occasionally a new mineral species is found. New uses for a mineral are frequently found, and as a result stimulus is given to searching for that particular substance.

LIBRARY

In addition to the numerous standard works, authoritative information on many phases of the mining and mineral industry is constantly being issued in the form of reports and bulletins by various government agencies.

The library of the Division of Mines contains over six thousand selected volumes on mines, mining and allied subjects, and it is also a repository for reports and bulletins of the technical departments of federal and state governments and of educational institutions, both domestic and foreign.

It is not the dearth of the latter publications, but rather a lack of knowledge of just what has been published and where the reports may be consulted or obtained, that embarrasses the ordinary person seeking specific information.

To assist in making the public acquainted with this valuable source of current technical information, California Journal of Mines and Geology contains under this heading a list of all books and official reports and bulletins received which pertain particularly to mining in California.

Files of all the leading technical journals will be found in the library, and county and state maps, topographical sheets and geological folios. Current copies of local newspapers published in the mining centers of the state are available for reference.

The library and reading room are open to the public during the usual office hours, when the librarian may be freely called upon for all necessary assistance.

OFFICIAL PUBLICATIONS RECEIVED WHICH ARE OF INTEREST ESPECIALLY TO CALIFORNIA MINING

Governmental, National.

U. S. Geological Survey:

Professional Papers:

182 The Tertiary Floras of Alaska by Philip S. Smith.

185 I Geomorphology of the North Flank of the Uinta Mountains. By Wilmot H. Bradley.

186 A New Upper Cretaceous Ostreidae from the Gulf Region by Lloyd W. Stephenson.

Bulletins:

678 Geology and Ground Water Resources of Uvalde and Medina Counties, Texas.

756 Surface Water Supply of the United States, 1934, Pt. 1 No. Atlantic Slope Basins.

757 Surface Water Supply of the United States, 1934, Pt. 2 So. Atlantic Slope and Eastern Gulf of Mexico Basins.

758 Surface Water Supply of the United States, 1934, Pt. 3 Ohio River Basin.

767 Surface Water Supply of the United States, 1934, Pt. 12 North Pacific Slope Basins.

770 Surface Water Supply of Hawaii, July 1, 1933, to June 30, 1934.
773 A Geology and Ground Water Resources of the Eliz. City area, North Carolina.
773 B Water Resources of the Edwards Limestone in San Antonio, area, Texas.
773 A Artesian Water in the Florida Peninsula.
775 Records of Wells on the Snake River Plain, Southeastern Idaho.
830 Contributions to Economics Geology, 1931–1932.
847 D Phosphate Rock near Maxville, Philipsburg and Avon, Montana.
850 Quicksilver Deposits of Southwestern Oregon.
852 The Book Cliffs Coal Field in Emery and Grand Counties, Utah.
860 B Geology and Fuel Resources of the Southern Part of the San Juan Basin, New Mexico.
863 Geology of the Salt Valley Anticline and Adjacent Areas, Grand County, Utah.
867 Geology of the Coastal Plain of South Carolina.

Topographic Sheets:

Acton Quadrangle, Los Angeles County.
Antelope Plain Quadrangle, Los Angeles County.
Bell Quadrangle, Los Angeles County.
Boneyard Canyon Quadrangle, Los Angeles County.
Camp Baldy Quadrangle, Los Angeles County.
Camp Bonita Quadrangle, Los Angeles County.
Camp Rincon Quadrangle, Los Angeles County.
Cima Mesa Quadrangle, Los Angeles County.
Del Sur Quadrangle, Los Angeles County.
Dudley Ridge Quadrangle, Kings County.
El Rico Rand Quadrangle, Kings County.
Enselsa Quadrangle, Humboldt County.
La Verne and Evey Canyon Quadrangle, Los Angeles County.
Mescal Creek Quadrangle, Los Angeles County.
North of Oildale Quadrangle, Kern County.
Red Mountain Quadrangle, Los Angeles County.
Redrock Mountain Quadrangle, Los Angeles County.
Valyermo Quadrangle, Los Angeles County.
Warm Spring Quadrangle, Los Angeles County.
White River Quadrangle.

U. S. Bureau of Mines:

Information Circulars:

6886—Shifts in Sources of Chromite Supply. By Robert H. Ridgway.
6889—Mining and Grinding Methods and Costs at the Camp Brothers Company Shale Pit, Mogadore, Ohio. By E. J. Lintner.
6891—Design and Operation of a Four-ton-per-hour Gold and Silver Ore-Sampling Plant. By E. D. Gardner and W. A. Leddell.
6892—Review of Literature on Effects of Breathing Dusts with Special Reference to Silicosis. Part III-B, Chapter 5: Economic and Legal Aspects of Dust Disease in Industry (Sections 3 and 4). By D. Harrington and Sara J. Davenport.
6897—Natural-Gasoline Plants in the United States, January 1, 1936. By G. R. Hopkins and E. M. Seeley.
6898—Costs of Trucking and Packing Ore in Western Gold-Mining Districts. By E. D. Gardner.
6899—Geophysical Prospecting for Underground Waters in Desert Areas. By F. W. Lee.
6900—Mining and Milling Methods and Costs at the Yellow Aster Mine, Randsburg, Calif. By Corwin L. Cooper.
6901—Gold Mining and Milling in the Black Mountains, Western Mohave County, Arizona. By E. D. Gardner.
6904—Milestones in Mine-Safety Legislation. By L. C. Ilsley.
6906—Petroleum Refineries, including Cracking Plants in the United States, January 1, 1936. By G. R. Hopkins and E. W. Cochrane.

Report of Investigations:
3306—Progress Reports—Metallurgical Division 12. Annual Report of the Metallurgical Division, Fiscal Year 1935. By R. S. Dean.
3308—The National Safety Competition of 1935. By W. W. Adams, T. D. Lawrence and D. R. White.
3311—Cooperative Fuel Research Motor-Gasoline Survey, Winter 1935–1936. By E. C. Lane and A. J. Kraemer.

Governmental, State.

Alabama Geological Survey, University.
Arizona Bureau of Mines, Tucson.
Arkansas Geological Survey, Little Rock.
Colorado Bureau of Mines, Denver.
Connecticut Geological and Natural History Survey, Hartford.
Florida Department of Conservation, Tallahassee.
Georgia Division of Geology, Atlanta.
Idaho Bureau of Mines and Geology, Moscow.
Illinois Geological Survey, Urbana.
Indiana Division of Geology, Indianapolis.
Iowa Geological Survey, Des Moines.
State Geological Survey of Kansas, Lawrence.
Kentucky Geological Survey, Frankfort.
Louisiana Department of Conservation, New Orleans.
Maine State Geologist, Augusta.
Maryland Geological Survey, Baltimore.
Michigan Geological Survey, Lansing.
Minnesota Geological Survey, Minneapolis.
Mississippi State Geological Survey, University.
Missouri Bureau of Geology and Mines, Rolla.
Montana Bureau of Mines and Geology, Butte.
Nebraska Geological Survey, Lincoln.
Nevada State Bureau of Mines, Reno.
New Jersey Department of Conservation and Development, Trenton.
New Mexico Bureau of Mines and Mineral Resources, Socorro.
North Carolina Geological and Economic Survey, Chapel Hill.
North Dakota Geological Survey, Grand Forks.
Ohio Geological Survey, Columbus.
Oklahoma Geological Survey, Norman.
Oregon Bureau of Mines and Geology, Corvallis.
Pennsylvania Topographic and Geological Survey, Harrisburg.
South Dakota State Geological Survey, Vermillion.
Tennessee Division of Geology, Nashville.
Texas Bureau of Economic Geology, Austin.
Virginia Geological Survey, University.
Washington State Department of Conservation and Development, Pullman.
West Virginia Geological Survey, Morgantown.
Wisconsin Geological and Natural History Survey, Madison.
Wyoming Geological Survey, Cheyenne.

Governmental, Foreign.

Alberta Research Council, Edmonton.
Argentina Direccion General de Minas y Geologica, Buenos Aires.
British Columbia Minister of Mines, Victoria.
British Museum and Natural History, London.
Canada Department of Mines, Ottawa.
Cuerpo de Ingenieros de Minas y Aguas del Peru, Lima.
Geological Service of Minas Geraes, Bella Horizonte, Brazil.
Geological Survey of Scotland.
Instituto Historica e Geographico Rio de Janeiro.
Museo de Historia Natural de Montevideo, Uruguay.
New South Wales Department of Mines, Sydney, Australia.
New Zealand Geological Survey Branch, Wellington.
Nova Scotia Department of Public Works and Mines, Halifax.

Ontario Department of Mines, Toronto, Canada.
Quebec Bureau of Mines, Quebec.
Queensland Department of Mines, Brisbane, Australia.
South Australia Department of Mines, Adelaide.
Western Australia Geological Survey, Perth.
Transvaal Chamber of Mines, Johannesburg, South Africa.

Societies and Educational Institutions.

Academia de Ciencias y Artes de Barcelona, Spain.
Academy of Natural Sciences of Philadelphia.
American Association of Petroleum Geologists, Tulsa, Oklahoma.
American Geographical Society of New York.
American Institute of Mining and Metallurgical Engineers, New York.
American Journal of Science, New Haven, Conn.
American Philosophical Society, Philadelphia.
Australian Museum, Sydney.
California Academy of Sciences, San Francisco.
Canadian Institute of Mining and Metallurgy, Montreal.
Carnegie Institution of Washington.
Cleveland Museum of Natural History, Cleveland, Ohio.
Colorado College Publications, Colorado Springs.
Colorado Scientific Society, Denver.
Commonwealth Club, San Francisco.
Economic Geology, Lancaster, Pa.
Field Museum of Natural History, Chicago.
Franklin Institute of the State of Pennsylvania, Lancaster, Pa.
Geological Society of America, Columbia University, New York.
Geographical Society of London.
Institution of Mining and Metallurgy, London.
Instituto Geologico de Mexico, Mexico, D. F.
Journal of Geology, Chicago.
Mineralogical Society of America, Menasha, Wisconsin.
Michigan College of Mining and Technology, Houghton.
Mining and Metallurgical Society of America, New York.
Museu Nacional, Rio de Janeiro.
National Research Council, Washington, D. C.
New York Academy of Sciences, New York.
New York State Museum, Albany.
Pennsylvania State College, State College.
Philippine Journal of Science, Manila.
Royal Society of South Australia, Adelaide.
Seismological Society of America, Stanford University.
Sierra Club, San Francisco.
Society of Economical Paleontologists and Mineralogists, Fort Worth, Texas.
Southern California Academy of Sciences, Los Angeles.
University of California Publications in Engineering, Berkeley.
University of California Publications in Geography, Berkeley.
University of California Publications in Geology, Berkeley.
University of Harvard, Department of Mineralogy and Petrography, Cambridge, Mass.

Current Magazines on File.

For the convenience of persons wishing to consult the technical magazines in the reading room, a list of those on file is appended:

Asbestos, Philadelphia, Pennsylvania.
Brick and Clay Record, Chicago.
California Journal of Development, San Francisco.
California Mining Journal, Auburn.
California Oil World, Los Angeles.
California Safety News, San Francisco.
Canadian Mining Journal, Gardenvale, Quebec.
Chemical and Metallurgical Engineering, New York City.
Chemical Engineering and Mining Review, Melbourne, Australia.

Commonwealth, San Francisco.
Colorado School of Mines, Golden, Colorado.
Engineering and Mining Journal, New York City.
Fuel Oil, Chicago, Illinois.
Fusion Facts, Whittier, California.
Gemmologist, London.
Gold, Toronto, Canada.
Grizzly Bear, Los Angeles.
Hercules Mixer, Wilmington, Delaware.
Lubrication, The Texas Co., New York City.
Metals and Alloys, Pittsburgh, Pa.
Mineralogist, Portland, Ore.
Mining Congress Journal, Washington, D. C.
Mining Journal, London.
Mining Journal, Phoenix, Arizona.
Mining and Industrial News, San Francisco.
Mining and Metallurgy, New York City.
Mining Review, Salt Lake City.
Nickel Cast Iron News, New York City.
Northwest Mining, Spokane, Washington.
Oil and Gas Journal, Tulsa, Oklahoma.
Oil, Paint and Drug Reporter, New York City.
Oil Weekly, Houston, Texas.
Pacific Purchaser, San Francisco.
Petroleum World, Los Angeles.
Pit and Quarry, Chicago.
Queensland Government Mining Journal, Brisbane, Australia.
Rock Products, Chicago.
Rocks and Minerals, Peekskill, New York.
Sands, Clays and Minerals, Chatteris, England.
Scientific American, New York City.
Southwest Builder and Contractor, Los Angeles.
Stabilizer, Los Angeles.
Standard Oil Bulletin, San Francisco.
Stone, New York City.
Western Mining News, San Francisco.

Newspapers.

The following papers are received and kept on file in the library:

Alaska Weekly, Seattle, Washington.
Amador Dispatch, Jackson, California.
Banner, Sonora, California.
Barstow Printer, Barstow, California.
Bridgeport Chronicle-Union, Bridgeport, California.
Calaveras Californian, Angels Camp, California.
Calaveras Prospect, San Andreas, California.
Colusa Sun-Herald, Colusa, California.
Daily Commercial News, San Francisco, California.
Del Norte Triplicate, Crescent City, California.
Denver Mining Record, Denver, Colorado.
Georgetown Gazette, Georgetown, California.
Inland Oil Index, Casper, Wyoming.
Inyo Independent, Independence, California.
Inyo Register, Bishop, California.
Las Vegas Age, Las Vegas, Nevada.
Livermore Herald, Livermore, California.
Los Angeles Times, Los Angeles, California.
Mariposa Gazette, Mariposa, California.
Mercury Register, Oroville, California.
Mojave Miner, Kingman, Arizona.
Mojave-Randsburg Record, Mojave, California.
Morning Union, Grass Valley, California.
Mountain Messenger, Downieville, California.

Needles Nugget, Needles, California.
Nevada City Nugget, Nevada City, California.
Nevada Mining Bulletin, Las Vegas, Nevada.
Oil Marketer, Bayonne, New Jersey.
Placer Herald, Auburn, California.
Plumas Independent, Quincy, California.
Randsburg Times, Randsburg, California.
Shasta Courier, Redding, California.
Siskiyou News, Yreka, California.
Stockton Record, Stockton, California.
Tehachapi News, Tehachapi, California.
Terra Bella News, Terra Bella, California.
Tuolumne Independent, Sonora. California.
Tuolumne Prospector, Tuolumne, California.
Union Democrat, Sonora, California.
Weekly Trinity Journal, Weaverville, California.
Western Mineral Survey, Salt Lake City, Utah.
Western Sentinel, Etna Mills, California.
Yreka Journal, Yreka, California.

New Books Received by the Library.

Handbook for the Amateur Lapidary. By J. Harry Howard.
Rotary Drilling Handbook. By J. E. Brantly.
International Geological Congress. Report of the XVI Session, United States of America, 1933, Volume I, Washington, 1936.
International Geological Congress, Report of the XVI Session, United States of America, 1933, Volume 2, Washington, 1936.
U. S. Bureau of Mines, Minerals Yearbook for 1936.

PRODUCERS AND CONSUMERS

The producer and consumer of mineral products are mutually dependent upon each other for their prosperity, and one of the most direct aids rendered by this Division to the mining industry in the past has been that of bringing producers and consumers into direct touch with each other.

This work has been carried on largely by correspondence, supplemented by personal consultation. Lists of buyers of all the commercial minerals produced in California have been made available to producers upon request, and likewise the owners of undeveloped deposits of various minerals, and producers of them, have been made known to those looking for raw mineral products.

When the publication of *Mining in California* was on a monthly basis, current inquiries from buyers and sellers were summarized and lists of mineral products or deposits 'wanted' or 'for sale' included in each issue.

It is important that inquiries of this nature reach the mining public as soon as possible and in order to avoid the delay incident to the present quarterly publication of CALIFORNIA JOURNAL OF MINES AND GEOLOGY, these lists are now issued monthly in the form of a mimeographed sheet under the title of 'Commercial Mineral Notes.' and sent to those on the mailing list of CALIFORNIA JOURNAL OF MINES AND GEOLOGY.

EMPLOYMENT SERVICE

Following the establishment of the Mining Division branch offices in 1919, a free technical employment service was offered as a mutual aid to mine operators and technical men for the general benefit of the mineral industry.

Briefly summarized, men desiring positions are registered, the cards containing an outline of the applicant's qualifications, position wanted, salary desired, etc., and as notices of 'positions open' are received, the names and addresses of all applicants deemed qualified are sent to the prospective employer for direct negotiations.

Telephone and telegraphic communications are also given immediate attention.

Technical men, or those qualified for supervisory positions, and vacancies of like nature only, are registered, as no attempt will be made to supply common mine and mill labor.

Registration cards for the use of both prospective employers and employees may be obtained upon request, and a cordial invitation is extended to the industry to make free use of the facilities afforded. Parties interested should communicate direct with our San Francisco office.

PUBLICATIONS OF THE DIVISION OF MINES

During the past fifty-six years, in carrying out the provisions of the organic act creating the former California State Mining Bureau, there have been published many reports, bulletins and maps which go to make up a library of detailed information on the mineral industry of the State, a large part of which could not be duplicated from any other source.

One feature that has added to the popularity of the publications is that many of them have been distributed without cost to the public, and even the more elaborate ones have been sold at a price which barely covers the cost of printing.

Owing to the fact that funds for the advancing of the work of this department have usually been limited, the reports and bulletins mentioned are printed in limited editions many of which are now entirely exhausted.

Copies of such publications are available for reference, however, in the offices of the Division of Mines, in the Ferry Building, San Francisco; State Building, Los Angeles; State Office Building, Sacramento; Redding; and Division of Oil and Gas at Santa Barbara, Taft, Bakersfield, Coalinga. They may also be found in many public, private and technical libraries in California and other States and foreign countries.

A catalog of all publications from 1880 to 1917, giving a synopsis of their contents, is issued as Bulletin No. 77.

Publications in stock may be obtained by addressing any of the above offices and enclosing the requisite amount in the case of publications that have a list price. Only coin, stamps or money orders should be sent, and it will be appreciated if remittance is made in this manner rather than by personal check.

Money orders should be made payable to Division of Mines.

Purchasers in California add 3 per cent sales tax.

NOTE.—The Division of Mines frequently receives requests for some of the early Reports and Bulletins now out of print, and it will be appreciated if parties having such publications and wishing to dispose of them will advise this office.

REPORTS

Asterisks (**) indicate the publication is out of print.

	Price[a]	Shipping Charges
**First Annual Report of the State Mineralogist, 1880, 43 pp. Henry G. Hanks	----	----
**Second Annual Report of the State Mineralogist, 1882, 514 pp., 4 illustrations, 1 map. Henry G. Hanks	----	----
**Third Annual Report of the State Mineralogist, 1883, 111 pp., 21 illustrations. Henry G. Hanks	----	----
**Fourth Annual Report of the State Mineralogist, 1884, 410 pp., 7 illustrations. Henry G. Hanks	----	----
**Fifth Annual Report of the State Mineralogist, 1885, 234 pp., 15 illustrations, 1 geological map. Henry G. Hanks	----	----
**Sixth Annual Report of the State Mineralogist, Part I, 1886, 145 pp., 3 illustrations, 1 map. Henry G. Hanks	----	----
Part II, 1887, 222 pp., 36 illustrations. William Irelan, Jr.	$0.50	$0.10
**Seventh Annual Report of the State Mineralogist, 1887, 315 pp. William Irelan, Jr.	----	----
**Eighth Annual Report of the State Mineralogist, 1888, 948 pp., 122 illustrations. William Irelan, Jr.	----	----
Ninth Annual Report of the State Mineralogist, 1889, 352 pp., 57 illustrations, 2 maps. William Irelan, Jr.	1.00	.15
**Tenth Annual Report of the State Mineralogist, 1890, 983 pp., 179 illustrations, 10 maps. William Irelan, Jr.	----	----
Eleventh Report (First Biennial) of the State Mineralogist, for the two years ending September 15, 1892, 612 pp., 73 illustrations, 4 maps. William Irelan, Jr.	1.00	.20
**Twelfth Report (Second Biennial) of the State Mineralogist, for the two years ending September 15, 1894, 541 pp., 101 illustrations, 5 maps. J. J. Crawford	----	----
**Thirteenth Report (Third Biennial) of the State Mineralogist, for the two years ending September 15, 1896, 726 pp., 93 illustrations, 1 map. J. J. Crawford	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1913–1914, Fletcher Hamilton:		
**Mines and Mineral Resources, Amador, Calaveras and Tuolumne Counties, 172 pp., paper	----	----
Mines and Mineral Resources, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma and Yolo Counties, 208 pp., paper	.50	.10
**Mines and Mineral Resources, Del Norte, Humboldt and Mendocino Counties, 59 pp., paper	----	----
**Mines and Mineral Resources, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin and Stanislaus Counties, 220 pp., paper	----	----
**Mines and Mineral Resources of Imperial and San Diego Counties, 113 pp., paper	----	----
**Mines and Mineral Resources, Shasta, Siskiyou and Trinity Counties, 180 pp., paper	----	----
**Fourteenth Report of the State Mineralogist, for the Biennial Period 1913–1914, Fletcher Hamilton, 1915: A general Report on the Mines and Mineral Resources of Amador, Calaveras, Tuolumne, Colusa, Glenn, Lake, Marin, Napa, Solano, Sonoma, Yolo, Del Norte, Humboldt, Mendocino, Fresno, Kern, Kings, Madera, Mariposa, Merced, San Joaquin, Stanislaus, San Diego, Imperial, Shasta, Siskiyou and Trinity Counties, 974 pp., 275 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1915–1916. Fletcher Hamilton:		
**Mines and Mineral Resources, Alpine, Inyo and Mono Counties, 176 pp., paper	----	----
Mines and Mineral Resources, Butte, Lassen, Modoc, Sutter and Tehama Counties, 91 pp., paper	.50	.05
**Mines and Mineral Resources, El Dorado, Placer, Sacramento and Yuba Counties, 198 pp., paper	----	----
**Mines and Mineral Resources, Monterey, San Benito, San Luis Obispo, Santa Barbara and Ventura Counties, 183 pp., paper	.65	.10
**Mines and Mineral Resources, Los Angeles, Orange and Riverside Counties, 136 pp., paper	----	----
**Mines and Mineral Resources, San Bernardino and Tulare Counties, 186 pp., paper	----	----

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[a] Purchasers in California add 3 per cent sales tax.

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**Fifteenth Report of the State Mineralogist, for the Biennial Period 1915–1916, Fletcher Hamilton, 1917; A General Report on the Mines and Mineral Resources of Alpine, Inyo, Mono, Butte, Lassen, Modoc, Sutter, Tehama, Placer, Sacramento, Yuba, Los Angeles, Orange, Riverside, San Benito, San Luis Obispo, Santa Barbara, Ventura, San Bernardino and Tulare Counties, 990 pp., 413 illustrations, cloth	----	----
Chapters of the State Mineralogist's Report, Biennial Period, 1917–1918, Fletcher Hamilton:		
Mines and Mineral Resources of Nevada County, 270 pp., paper	$0.75	$0.15
Mines and Mineral Resources of Plumas County, 188 pp., paper	.50	.10
Mines and Mineral Resources of Sierra County, 144 pp., paper	.50	.10
Seventeenth Report of the State Mineralogist, 1920, 'Mining in California during 1920,' Fletcher Hamilton; 562 pp., 71 illustrations, cloth	1.75	.25
Eighteenth Report of the State Mineralogist, 1922, 'Mining in California,' Fletcher Hamilton. Chapters published monthly beginning with January, 1922:		
**January, **February, **March, April, **May, June, July, August, September, October, **November, December, 1922	.25	.05
Chapters of Nineteenth Report of the State Mineralogist, 'Mining in California,' Fletcher Hamilton and Lloyd L. Root. January, February, March, September, 1923	.25	.05
Chapters of Twentieth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly. January, April, July, October, 1924, per copy	.25	.05
Chapters of Twenty-first Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1925, Mines and Mineral Resources of Sacramento, Monterey and Orange Counties	.25	.05
April, 1925, Mines and Mineral Resources of Calaveras, Merced, San Joaquin, Stanislaus and Ventura Counties	.25	.05
**July, 1925, Mines and Mineral Resources of Del Norte, Humboldt and San Diego Counties	.25	.10
**October, 1925, Mines and Mineral Resources of Siskiyou, San Luis Obispo and Santa Barbara Counties	----	----
Chapters of Twenty-second Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
**January, 1926, Mines and Mineral Resources of Trinity and Santa Cruz Counties	.25	.10
April, 1926, Mines and Mineral Resources of Shasta, San Benito and Imperial Counties	.25	.10
July, 1926, Mines and Mineral Resources of Marin and Sonoma Counties	.25	.05
**October, 1926, Mines and Mineral Resources of El Dorado and Inyo Counties, also report on Minaret District, Madera County	----	----
Chapters of Twenty-third Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1927, Mines and Mineral Resources of Contra Costa County; Santa Catalina Island	.25	.10
April, 1927, Mines and Mineral Resources of Amador and Solano Counties	.25	.05
**July, 1927, Mines and Mineral Resources of Placer and Los Angeles Counties	.25	.10
October, 1927, Mines and Mineral Resources of Mono County	.25	.05
Chapters of Twenty-fourth Report of the State Mineralogist, 'Mining in California,' Lloyd L. Root. Published quarterly:		
January, 1928, Mines and Mineral Resources of Tuolumne County	.25	.05
April, 1928, Mines and Mineral Resources of Mariposa County	.25	.05
July, 1928, Mines and Mineral Resources of Butte and Tehama Counties	.25	.05
October, 1928, Mines and Mineral Resources of Plumas and Madera Counties	.25	.05
Chapters of Twenty-fifth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**January, 1929, Mines and Mineral Resources of Lassen, Modoc and Kern Counties; also on Special Placer Machines	----	----
April, 1929, Mines and Mineral Resources of Sierra, Napa, San Francisco and San Mateo Counties	$0.25	$0.10
July, 1929, Mines and Mineral Resources of Colusa, Fresno and Lake Counties	.25	.10
October, 1929, Mines and Mineral Resources of Glenn, Alameda, Mendocino and Riverside Counties	.25	.10
Chapters of Twenty-sixth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1930, Mines and Mineral Resources of Santa Clara County; also Barite in California	.25	.05
**April, 1930, Mines and Mineral Resources of Nevada County; also Mineral Paint Materials in California	.25	.05
July, 1930, Mines and Mineral Resources of Yuba and San Bernardino Counties; also Commercial Grinding Plants in California	.25	.10
October, 1930, Mines and Mineral Resources of Butte, Kings and Tulare Counties; also Geology of Southwestern Mono County (Preliminary)	.25	.10
Chapters of Twenty-seventh Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1931, Preliminary Report on Economic Geology of the Shasta Quadrangle. Beryllium and Beryl. The New Tariff and Nonmetallic Products. Crystalline Talc. Decorative Effects in Concrete	.25	.10
April, 1931, Stratigraphy of the Kreyenhagen Shale. Diatoms and Silicoflagellates of the Kreyenhagen Shale. Foraminifera of the Kreyenhagen Shale. Geology of Santa Cruz Island	.25	.10
**July, 1931. (Yuba, San Bernardino.) Feldspar, Silica, Andalusite and Cyanite Deposits of California. Note on a Deposit of Andalusite in Mono County; its occurrence and chemical importance. Bill creating Trinity and Klamath River Fish and Game District and its effect upon mining	.25	.10
October, 1931. (Alpine.) Geology of the San Jacinto Quadrangle south of San Gorgonio Pass, California. Notes on Mining Activities in Inyo and Mono Counties in July, 1931	.25	.05
Chapters of Twenty-eighth Report of the State Mineralogist, 'Mining in California,' Walter W. Bradley. Published quarterly:		
January, 1932, Economic Mineral Deposits of the San Jacinto Quadrangle. Geology and Physical Properties of Building Stone from Carmel Valley. Contributions to the Study of Sediments. Sediments of Monterey Bay. Sanbornite	.25	.10
**April, 1932. Elementary Placer Mining Methods and Gold Saving Devices. The Pan, Rocker and Sluice Box. Prospecting for Vein Deposits. Bibliography of Placer Mining	----	----
Abstract from April quarterly: Elementary Placer Mining Methods and Gold Saving Devices. Types of Deposits, Simple Equipment. Special Machines. Dry Washing. Black Sand Treatment. Marketing of Products. Placer Mining Areas. Laws. Prospecting for Quartz Veins. Bibliography (mimeographed)	.20	.05
July-October. (Ventura.) Report accompanying Geologic Map of Northern Sierra Nevada. Fossil Plants in Auriferous Gravels of the Sierra Nevada. Glacial and Associated Stream Deposits of the Sierra Nevada. Juarassic and Cretaceous Divisions in the Knoxville-Shasta Succession of California. Geology of a Part of the Panamint Range. Economic Report of a Part of the Panamint Range. Acquiring Mining Claims Through Tax Title. The Biennial Report of State Mineralogist	.50	.15
Chapters of Report XXIX, 1933 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
January-April. Gold Deposits of the Redding and Weaverville Quadrangles. Geologic Formations of the Redding-Weaverville District, Northern California. Geology of Portions		

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
of Del Norte and Siskiyou Counties. Applications of Geology to Civil Engineering. The Lakes of California. Discovery of Piedmontite in the Sierra Nevada. Tracing 'Buried River' Channel Deposits by Geomagnetic Methods. Geologic Map of Redding-Weaverville District, showing gold mines and prospects. Geologic Map showing various mines and prospects of part of Del Norte and Siskiyou Counties	$0.80	$0.15
July-October. Gold Resources of Kern County. Limestone Deposits of the San Francisco Region. Limestone Weathering and Plant Associations of the San Francisco Region. Booming. Death Valley National Monument, California. Placer Mining Districts, Senate Bill 480. Navigable Waters, Assembly Bill 1543	.80	.10
Chapters of Report XXX, 1934 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
January. Resurrection of Early Surfaces in the Sierra Nevada. Geology and Mineral Resources of Northeastern Madera County. Geology and Mineral Deposits of Laurel and Convict Basins, Southwestern Mono County. Notes on Sampling as Applied to Gold Quartz Deposits	.40	.10
April-July. Elementary Placer Mining in California and Notes on the Milling of Gold Ores	.80	.10
October. Current Mining Developments in Northern California. Current Mining Activity in Southern California. Geology and Mineral Resources of the Julian District, San Diego County. Geology and Mineral Resources of Elizabeth Lake Quadrangle. Dry Placers of Northern Mojave Desert. Biennial Report of State Mineralogist. Assessment Work Within Withdrawn Areas	.40	.10
Chapters of Report XXXI, 1935 (quarterly): titled "California Journal of Mines and Geology"		
January. Review of Gold Mining in East-Central, 1934. Current Mining Activities in the San Francisco District with Special Reference to Gold. Geological Investigation of the Clays of Riverside and Orange Counties, Southern California. Information regarding Mining Loans by the Reconstruction Finance Corporation	.40	.10
April. A Geologic Section Across the Southern Peninsular Range of California. New Technique Applicable to the Study of Placers. Grubstake Permits	.40	.10
July. Mines and Mineral Resources of Siskiyou County (with map). Dams for Hydraulic Mining Debris. Leasing System as Applied to Metal Mining. Mine Financing in California. New Laws Make Radical Change in Mining Rights	.40	.10
October. Mines and Mineral Resources of San Luis Obispo County. Mineral Resources of Portions of Monterey and Kings Counties. Mining Activities at Soledad Mountain and Middle Buttes-Mojave District, Kern County. Geology of a Portion of the Perris Block, Southern California. Mineral Resources of a Portion of the Perris Block, Riverside County	.40	.10
Chapters of Report XXXII, 1936 (quarterly): titled "California Journal of Mines and Geology," containing the following:		
January (Placer Co., gold mines of), includes a description of drag-line dredgers and their operations; Geologic Report on Borax Lake	.40	.10
April. Geology, mining and processes of diatomite at Lompoc, Santa Barbara Co.; Essentials in developing and financing a prospect into a mine; Gold-bearing veins of Meadow Lake District, Nevada Co.; California semi-precious gem stones	.40	.10
July. Mines and Mineral Resources of Calaveras County; Placer Mining in California by Power Shovel; Assessment Work on Mining Claims Within Withdrawn Areas; Joshua Tree National Monument; Cost of Producing Quicksilver at a California Mine in 1931–1932; The Age of Mineral Utilization	.40	.10
October. Mines and Mineral Resources of Lassen County; Mines and Mineral Resources of Modoc County; Mechanics of the Lone Mountain Landslides, San Francisco; Biennial		

REPORTS—Continued

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
Report of the State Mineralogist; Properties and Industrial Applications of Opaline Silica	$0.40	$0.10
Subscription, $1.75 postpaid, in advance (by calendar year only).		
Chapters of State Oil and Gas Supervisor's Report:		
Summary of Operations—California Oil Fields, July, 1918, to March, 1919 (one volume)	Free	----
Summary of Operations—California Oil Fields. Published monthly, beginning April, 1919:		
**April, **May, **June, **July, **August, **September, **October, **November, **December, 1919	----	----
**January, **February, **March, **April, **May, **June, **July, **August, **September, **October, **November, **December, 1920	----	----
January, **February, **March, April, **May, **June, **July, August, **September, **October, **November, **December, 1921	Free	----
January, February, March, April, May, June, **July, **August, September, **October, **November, December, 1922	Free	----
January, February, **March, **April, May, **June, **July, August, September, **October, November, **December, 1923	Free	----
January, February, March, April, May, June, **July, August, September, October, November, December, 1924	Free	----
January, February, March, April, May, June, July, August, September, October, November, December, 1925	Free	----
January, February, March, April, May, June, July, August, September, October, November, December, 1926	Free	----
January, February, March, April, May, June, July, August, September, October, November, December, 1927	Free	----
January, February, March, April, May, June, July, August, September, October, **November, **December, 1928	Free	----
January, February, March, April, May, June, July-August-September, October-November-December, 1929	Free	----
(Published quarterly beginning July, 1929.)		
January-February-March, April-May-June, July-August-September, October-November-December, 1930	Free	----
January-February-March, April-May-June, July-August-September, 1931	Free	----
January, February, March, April, May, June, July, August, September, October, November, December, 1932	Free	----
January, February, March, 1933	Free	----
April, May, June, 1933	Free	----
July, August, September, 1933	Free	---

BULLETINS

Asterisks (**) indicate the publication is out of print.

	Price	Shipping Charges
**Bulletin No. 1. A Description of Some Desiccated Human Remains, by Winslow Anderson. 1888, 41 pp., 6 illustrations	----	----
**Bulletin No. 2. Methods of Mine Timbering, by W. H. Storms. 1894, 58 pp., 75 illustrations	----	----
**Bulletin No. 3. Gas and Petroleum Yielding Formations of Central Valley of California, by W. L. Watts. 1894, 100 pp., 13 illustrations, 4 maps	----	----
**Bulletin No. 4. Catalogue of California Fossils, by J. G. Cooper, 1894, 73 pp., 67 illustrations. (Part I was published in the Seventh Annual Report of the State Mineralogist, 1887)	----	----
**Bulletin No. 5. The Cyanide Process, 1894, by Dr. A. Scheidel. 140 pp., 46 illustrations	----	----
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**Map of Forest Reserves in California	----	----
**Mineral and Relief Map of California	----	----
**Map of El Dorado County, Showing Boundaries.National Forests	----	----
**Map of Madera County, Showing Boundaries, National Forests	----	----
**Map of Placer County, Showing Boundaries, National Forests	----	----
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**Map of Mother Lode Region	----	----
**Map of Desert Region of Southern California	----	----
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DETERMINATION OF MINERAL SAMPLES

Samples (limited to one at one time) of any mineral found in the State may be sent to the Division of Mines for identification, and the same will be classified free of charge. No samples will be determined if received from points outside the State. It must be understood that no assays, or quantitative determinations will be made. Samples should be in lump form if possible, and marked plainly with name of sender on outside of package, etc. No samples will be received unless delivery charges are prepaid. A letter should accompany sample, giving locality where mineral was found and the nature of the information desired.

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